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ON THE FAILURE OF

GEOLOGICAL ATTEMPTS IN GREECE

PRIOR TO THE EPOCH OF ALEXANDER.

BY

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PART I.

LONDON:
PUBLISHED BY TAYLOR AND FRANCIS, RED LION COURT, FLEET STREET.
1862.

135. d. 3.

PREFACE.

In presenting this volume to the English public, I do not pretend to have opened new sources for the elucidation of terrestrial science. Geology is the acquirement of the nineteenth century; its primitiæ owe their origin entirely to modern genius. Unlike Astronomy, the discoverer of the present heliocentric system of which himself confessed that he borrowed the idea from a Greek record, this young branch of human knowledge owes none of its present systems to ancient suggestion. Therefore I cannot find fault with the philosophical author of the 'History of the Inductive Sciences,' who devotes no separate article to Greek geological attempts. Strictly speaking, the Greeks had no geology at all. For it would appear rather an insult to the manes of a Werner, a W. Smith, or a Cuvier to term so the attempts which their philosophers made to arrive at a geogony.

But when we take into consideration the part the Grecian tribes were destined to perform in the history of the civilization of the Caucasian race, when we consider what admiration in many intellectual respects they have ever received from posterity, our curiosity is, of course, excited to establish, on as trustworthy a ground as possible, even their unsuccessful attempts (made perhaps inductively) to construct the history of the past vicissitudes of our earth.

Now this has not yet been done.

Much ingenuity has been expended both by medieval and modern writers who from time to time have ventured to decipher alarm-awaking scientific inheritances from this or that classical passage, or even from some classical allegory. Now no sober scholar would have ever relied, if rigorously educated in classical literature, essentially upon the exclusive authority of a Diogenes Laertius, Iamblichus, Porphyry, or Stobæus in preference to a clear testimony of Xenophon, Aristotle, Theophrastus, or Aristoxenus.

I have therefore undertaken to collect and submit to a critical review all those treatises and passages in classical literature which make an obvious allusion to geological observation. Although I have remarked above, that I utterly disclaim anything like a vindication of an ancient Greek geology, I use these expressions, "geology" and "geological," in the sequel of the present volume, just as I use the words "creation," "created," attaching to them, however, a wider signification.

I think the reader will perceive that throughout the volume I have intended to confine my review to data the authenticity of which was never questioned by philologists. I felt no ambition whatever to build up instantly a whole system, where the mutilated state of the preserved remains left but one single reference. I felt that in no part of scientific history does the annalist run so great a risk of being seduced by a certain group of circumstances to unscientific suggestions as just here. My researches can boast of two points only which are entitled to be regarded as somewhat pretensive suggestions—the doctrine of a geological central fire, and the palæontological theory of Empedocles. The former had been animadverted upon by Prof. Röth, but in terms which required essential modifications. And even there I would not for a single moment capriciously insist upon the precise historical character of the facts; I propose my view as a hypothesis to facilitate the solution of many serious difficulties respecting the Pythagorean philosophy. The question whether the rotation of the earth on her axis was taught or not by Plato's 'Timæus,' might not receive hence any decisive answer. The views of Martin, Cousin, Gruppe, Böckh, Letronne, Prantl, Whewell, and Grote will perhaps receive only very faint illustration from my allusions: what I attach importance to in Prof. Gruppe's words are not his arguments with regard to the 'Timæus,' but his and Jakobi's observations on the seventh book of Plato's 'Laws.' As to the former, I am rather inclined to excuse those who side with Böckh or even with Grote; but as to the latter, I consider Gruppe as yet unrefuted. At the same time, I feel no logical necessity to interpret Vitruvius in the same manner with Böckh and Humboldt's 'Kosmos.'

As to Empedocles, I seriously intended to exercise myself, so to say, in the virtue of abstinence from vague conjectures and startling generalizations. More detailed appreciations might perhaps result from future inquiries. I purpose to furnish these my researches with a complete philological apparatus: this more extensive edition will perhaps leave the press in the course of a year. I have added some notes, proofs, and illustrations, as well as three appendices also to the present, which I would have regarded rather as a precursory *résumé* of the facts observed. Yet, I fear, the scientific reader, if not a philologist, will feel some annoyance at being brought into collision with passages or expressions quoted in the original language. For the present I could not help this disadvantage. I was eager to secure as soon as possible the data I have accumulated; and for this purpose I deemed it best, in default of scientifically establishable translations, to cite the original terms in the text, and to give some conjectures in the Notes.

Besides this, I trespassed against the elegance of English style, by retaining such epithets as the "*φυσικοί*," "*φυσιολογία*," "*διαδοχή*," &c. Those who have spent hours of toil in dealing with the minutiæ of classical cosmical philosophy and literary peculiarities, will excuse me for having so piously preserved, even in a work in which I must condemn Greek genius, these antique characteristics. Finally, I must declare that while examining Greek dissertations, dissentient as I am from Sir C. Lewis, I shall always acknowledge the necessity of searching after connexions or analogies in other ancient literatures, as *e.g.* the Egyptian, Cuneatic, Sanskrit, Hebrew, Chinese, &c., but I shall never go so far as the ingenious German who attempted to prove, by the aid of otherwise respectable erudition, that the doctrine of Pythagoras was traceable to the Chinese, that of Anaxagoras to the Hebrew, that of the Eleates to the Hindoo, and that of Heraclitus to that of Zoroaster. Such inquiries are ever liable, learned and skilful as they are, to an important error: they derive their conclusions from analogous traits of a metaphysical and moral description. Such historians forget that a certain uniformity of human *à-priori-reasoning*, *deductive philosophy*, in the intellectual life of races inhabiting the most remote latitudes, might be admitted even by ethnologists who lay claim to different foci of creation, and reject every close early communication as effected in consequence of affiliations. Surely if men of science had separated from the so-called systems of those philosophers those parts which appear at first sight as the result of, perhaps rough, but undoubtful astronomical, zoological, botanical, mineralogical, and quasi-geological observations, and then looked for some allied phenomena within the ken of the nations above referred to, such a confusion would never have arisen. Those marvellous systems of the ancients owed, as every all-embracing system, their chief features to individual *taste*; and the shaded gradations of the latter *may* coincide in a striking manner within the scope of the most different nations, yet the objects and phenomena which may have been observed by them as innate to the heavenly space or to the terraqueous crust, never.

Stuhlweissenburg, in Hungary, April 6, 1862.

SYNOPSIS

OF THE

SUBJECTS TREATED UPON IN THE FORTHCOMING WORK OF THE AUTHOR; ANSWERING ALSO AS A KEY TO THOSE MENTIONED IN THE FOLLOWING ESSAY.

BOOK I.

Introduction.—The importance of Greek Culture in the History of the Civilization of the Caucasian Race.—The preceding generations have sufficiently studied its traits in metaphysical, psychological, and moral results, nay, even in the most unimportant minutiæ of their social existence.—Only the establishing of their merits in regard to the appreciation of our earth's autobiography, as exposed in the various rocky strata, was till now entirely neglected, at least from a scientific point of view.—Nor could there have been any encouragement to such a task in former centuries.—This could be done with success only in our own days.—I purpose to write the geology of the Greeks to the epoch of Alexander the Great.—Difficulties inherent in such a performance.—Arrangement of the work.—Division of matter.—The reaction of the interior of our planet on its surface.—Earthquakes.—The importance of literary remains registering these phenomena.—Its Ætiology.—Mythological attempts, popular creed, &c.—Theories of Natural Philosophers.—The didactic poem entitled 'Περὶ σεισμῶν,' attributed generally to Orpheus, a forgery of later date bespeaking Chaldean tenets.—Earthquakes in cosmical catastrophes.—Thermal water.—Volcanic phenomena classified by Baron Humboldt in the third group.—Veritable volcanoes.—The ætiologies of the last three classes of volcanic phenomena.—Typhoëus, Hephæstus, Cabiri, Telchines, Dactyli Idæi, &c.—Theories adopted by men of science.—Pyriphlegethon.—Internal heat.—The "*Central Fire*" of the Pythagoreans, in the view of the better-informed, analogous to our modern "fusible state of things in the interior of our globe."—Astronomical sense of the "*μέσον πῦρ*."—Its possession also of a geological meaning.—Simplicius.—The '*Φαίδων*' of Plato.—Heraclides of Pontus.—Prof. Röth's argumentation insufficient. —Prof. Gruppe of Berlin.—The volcanistics of Empedocles support the above idea.—Aristotle no arbiter of the subject.—The deficiency of his literary resources illustrated.—His contempt of the achievements of his predecessors.—A review of the philological and historical critics who have attacked the Pythagorean sect.—Internal causes which have, at the first superficial glance, alienated every sober scholar, and attracted only admirers of the fantastic.—The enthusiasm and theatrical extravagances of the Pythagoreans shown to be traceable to other causes than mere imposture or raving madness.—Pythagoras one of the greatest teachers who have educated the white races.—His connexion with Orpheus.—The solution of the problem respecting the "*ἐκπύρωσις*" elucidated by the acceptation of a geological "*μέσον πῦρ*."—Empedocles throws himself, according to the traditionary account, into the crater of Etna.

BOOK II.

Changes now in operation in the inorganic world.—The alternation of water and dry land.—Supposed desiccation of the sea.—Newly formed islands.—Removal of lakes—Transport of detritus.—Reproductive effects of aqueous causes, especially of rivers.—Formation of deltas.—Changes subversive of the surface of dry land.—Imperceptible rise and subsidence of land.—Sudden elevation of mountains.—Abrasion and erosion: the phenomena produced by their action on plains and valleys.—The observation of the phenomena popular.—Puerile pleasantries of the poets respecting rivers.—Special predilection of the Greeks for speculation on the origin of springs.—Asserted merits of Pythagorean observation.—Aristotle: his immortal lines in the first book of his '*Μετεωρολογικῶν.*'—Atmospheric action: decomposition.—The dream of Epimenides, and the tale of the Seven Sleepers.

BOOK III.

The same changes of the organic world now in progress.—Observed changes within the limits of animal and vegetable forms of life.—The Ancient Greeks and the modern conception of "species."—Spontaneous generation in connexion with the subject.—Popular creed.—How far the reforms introduced by the Stagirite into zoology deserve modifying in former generalizations.—The degradation of the human race.—Extinction of species.—Real importance of some ancient data informing us of the sudden extraordinary multiplication of certain animals, as of mice, serpents, frogs, &c.

BOOK IV.

Ancient schools of philosophy, as classified by modern writers, ought not to confuse the geologist.—Physical formation of our earth as unfolded in the different systems of natural philosophers.—Philological excursion for settling the question of the existence of an ancient term for the idea of stratum.—Geogonics.—Thales and his predecessors.—Pherecydes.—Pythagoras and the Pythagoreans.—Hippo and other pupils.—Anaximander.—Anaximenes.—Anaxagoras.—Archelaus.—Xenophanes.—Parmenides.—Melissus.—Heraclitus.—Diogenes of Apollonia.—Empedocles.—Zeno the Eleate.—Leucippus and Democritus.—Echoes in the Literature of Greece.—How far ought we to take notice of Gorgias, Protagoras, Hippias, &c.?—Plato.—Aristotle.—The revolutions our earth was supposed to have since undergone.—The traces of "κατακλυσμοί," "ἐμπρησμοί" or "ἐκπυρώσεις."—Periodical destruction of the world.—Tenets as regards the "ἀποκατάστασις" in general.—Oriental traditions and Greek natural philosophy.—The "διακύσμησις κατά τινας περιόδους" admits a most exclusive acceptation, excepting, perhaps, in Anaxagoras.—Reflections on the possibility of the Clazomenean's having been the precursor of Sir Charles Lyell.—Infinite number of worlds shown not always to mean those coexistent in space, but, as regards the inductive "φυσικοί," those subsequent to each other in time.—An essay on the belief in the eternity of the Great Universe.

BOOK V.

Origin of the animal and vegetable kingdoms.—Local traditions as to the first appearance of organic types.—Innumerable foci of creation.—The unity of the human race not to be deduced from a Greek point of view.—The theories of the "φυσικοί."—Isolated hints on the subject to be met with in the various relics of their literature.—Prevalence of the hypothesis of spontaneous generation.—Possible exceptions to the rule.—The theory of progressive development taught by all Greek natural philosophers.—Two classes of "φυσιολόγοι": the one tempted to such doctrines by psychological necessity, in consequence of reflecting on moral phenomena; the other by the observation of fossil remains.—Palæontological theory of Empedocles alone amongst the ancient Greeks preserved; the difference between the scale of the Agrigentine philosopher and those of modern date. How far fossil remains attracted universal attention.—An essay on the Greek popular creed as to the origin of the so-called bones of giants.—The late Prof. Lassaulx of Munich.—Fossil relics of Pachydermata and other colossal mammals probably venerated objects of early religion.—Samothrace and the Cabiri. —The palæontologists of that period.—Xanthus the Lydian.—The merits of Herodotus.—Xenophanes a most careful investigator.—Anaximander partially understood by Cuvier.—Oriental traditions.—Oannes, Hindoo Mythology.—Empedocles.—Archelaus deserves more attention.—Democritus.—Aristotle refuses fellowship with the ancient "φυσιολόγοι."—He deals with the present state of things; the sentiment expressed in his celebrated apophthegm rendered him indifferent to the changes which sublunar nature, both organic and inorganic, might have undergone.— He does not appreciate Empedocles.—His and his pupil Theophrastus's absurd idea, compared with the notions of Xenophanes.—Strange light cast upon ancient scientific "διαδοχή," both Roman and Greek, by Pomponius Mela.—Fossils, and the Great Year.

BOOK VI.

Summary of facts established.—A retrospective glance on the tragical fate of Greek natural philosophers.—Diminutiveness of the cosmical horizon of the Greeks when compared to the grandeur of that of the nineteenth century.—Causes which retarded the progress of Greek geology.—The deficiency of literary "διαδοχή."—Public attention exhausted in the affairs of state.—Influence of democracy, aristocracy, and monarchy on intellectual development in general, and more particularly on the vicissitudes of Greek natural philosophy.—The antagonism of the Priesthood.—The intrigues of the Oracles.—Sophists.—The advocates of practical life and material happiness.—The part of Socrates.—The questions of the day.—Greek genius itself.—Relation of Greek life to the observation of the marvels of the universe.—Plato: a humiliating truth.

ON THE FAILURE OF
GEOLOGICAL ATTEMPTS IN GREECE
PRIOR TO THE EPOCH OF ALEXANDER.

INTRODUCTION.

In moments of importance, white races generally allude to the ruins of Greek antiquity. Slumbering as if in a heavy dream, we are accustomed to consider many things to be the common attributes of mankind, which, only when drawing near to the heterogeneous appearance of Yua-Ming-Yua or Tenochtitlam, we become aware are nothing else than the vestiges of that bygone people which has left its impress upon our own civilization. So deeply rooted is every idea derived from the Greeks in the mental structure of the Caucasian races, that neither our thoughts nor tastes may hope for an easy emancipation. Yet, while in other great questions of human existence more than two chiliads have already sought the advice of its wisdom, it is only our own age that feels called upon to point out the degree of interest exhibited, as to the traces of our globe's past vicissitudes, by the preserved remainders of their literature. All that has been done before sinks into insignificance. Philologists proved themselves often unable to perceive connexions hidden in the text they meant to interpret; and naturalists lost courage at finding nothing agreeable to their purpose in Aristotle, the author whom they always distinguished. Unluckily, the extant writings of the latter offer to such inquirers very slight evidence; and so the memory of Hellas has been altogether condemned, before arriving at facts by the aid of a more serious investigation. Thence the most voluminous text-books of geology, when narrating the history of this science, devote attention to a few data which characterize the national direction of intellectual efforts, as collectively as insufficient as they are inadequate as respects their isolated position. Thence the several particular attempts of this kind, though full of unquestionable spirit, fall short of having a scientific value, with regard both to the material they ought to have collected, and to the point of view they ought to have started from. But the glory of the nineteenth century stands not in need of a negligent narrow-mindedness; the meaning which the accusers of Socrates attached to their expression, "ὑπὸ γῇ ἅπαντα ἀνεζητηκέναι," must be freed from embarrassments; and so must the allusion made by the Æschylian Prometheus to the prophetical virtue of Mother Earth foreshadowing to the Titan the future fall of Zeus's father.

I was therefore induced to review the whole of the ancient Greek literature, in the conviction that our present greatness might be augmented, if we were acquainted with the steps ventured towards a scheme of geology by the nation which fought the battle of Marathon and built the Parthenon. I knew that I ought not merely to study writers whose cosmical aims have become notorious in consequence of the formal conditions of their work—writers whose exclusive perusal has turned to the prejudice of Cuvier's 'Histoire des Sciences Naturelles,' I recognized the necessity of studying the metaphysicians and moralists of Greece, no less than the logographers, historians, and epistolographers—the epic and lyric, dramatic and didactic poets, no less than the mathematicians, phlyacographers, genealogists, composers of "Θαυμάσια ἀκούσματα," grammarians, hypomnematists, or scholiasts; for I had neither forgotten the fortuitous glances the former cast, from time to time, in their rhythmical onset, nor those of the latter, in the different turnings of their now more rigid, now more fickle prose. Nay, even, though I purpose merely to sketch the periods antecedent to the expedition of Alexander (periods antecedent also, in my view, to the decay of the pure Grecian prime), I ran over the agronomers, farriers, rhizotomers, hunters, bird-catchers, fishers, and cooks of the Alexandrine age, as well as over the Fathers, jurists, anthologists, and lexicographers of Byzantine days, paying in the meanwhile due attention to the Lavinian echoes.

The task proved irksome, albeit I did not greatly care what vestiges of Clazomenean, Abderitan, Milesian, or Ephesian tenets in the writings of Seid Sherif Djordjani or Seadeddin Teftasani could be traced; for it would have caused a most troublesome anxiety to touch upon the reconciliation of Arabian records with received Greek chronology and "*διαδοχή*," when historians like Abul Pharagius make Empedocles coëval with David—a work more troublesome, indeed, than the results probably to be obtained might recompense,—albeit I did care about mythologies exclusively in cases in which the key was handed down to us by some of the most sober authors of antiquity themselves, as in the case of the tale of Alcmæon the son of Amphiaraus, so beautifully explained by the masterly historian of the Peloponnesian War; because, without adhering strictly to the generalizations unfolded by Grote in the first volume of his 'History of Greece,' I knew well that I had to deal with a people who, as soon as they perceive a myrtle-tree in Trœzen, feel inclined to assert that its leaves have been perforated by the bodkin of the unfortunate Phædra foiled by Hippolytus —with a people who, seeing a solitary boulder lying near to the haven at Salamis, instead of recognizing its erratic nature, assert that it served as a seat to Telamon wistfully gazing after his sons who had just rowed away to join the fleet in Aulis,—albeit, finally, I did not take pains to inquire after the pragmatical value of proper names in the various MSS. as copied by harmless mediæval monks, because I knew that corrections like Xenophanes instead of Xenohipnes, or Xenocrates instead of Xenophanes, could only then be luckily accomplished in the case of the whole literature yet extant, when the immortal merits of an Immanuel Bekker shall be declared to admit a thoroughly new philological examination (the hope not of our age, but of centuries to come). The task proved, I say, irksome, nevertheless not without some harvest of success. To guess what an association of ideas on moonshiny nights the marbles of Periclean Athens may have witnessed from the friends of Aspasia—to guess what may have stimulated the "*μετεωρολέσχας*," hated and rejected as they were, to treat religious ceremonies, even when inherent in democratical institutions, with scorn and contempt—to comprehend the great figures of a Pythagoras and Anaximander, of an Empedocles and Anaxagoras, in their tragical aspect,

—all this will surely sweeten the pains of a sedentary life spent in working through Hesychius and Suidas, Castor and Pollux, the tedious Journal of the Patriarch, and the withering Violets of Imperial Eudocia.

Let me, then, before publishing my entire work furnished with all the critical apparatus required, give the following results to the disposal of our geologists.

CHAPTER I.

When tracing, in this chapter, how far the Greeks directed their mind to those phenomena which, in conformity with the opinions of some modern philosophers, are stated to bespeak a reaction of our planet's interior on its surface, I ought not to enlarge more amply the four classes proposed by the late Baron von Humboldt, than is necessary for the elucidation of ancient geological dynamics. Theories of earthquakes fall rather within the scope of terrestrial physics; the description of volcanoes rather within that of physical geography; their ætiology does, however, by no means disallow some logical connexion with the changes our earth has undergone. In my Appendix I shall restrict myself to a brief estimation of the so-called "igneous forces," and I intend to reserve the "aqueous forces" for my Second Chapter, partly because, the virtue of the latter being too obvious, they require no further categories of explanation, and partly because they appear too closely allied with the effects they produce to supply systematical terms in proportion to the former.

Far more instructive is it, however, to learn by what generalizations the learned of Greece have been seduced in their inquiry into the final cause of volcanic phenomena. Aristotle faintly alludes to the subject in the chapter in which he treats of earthquakes; and though we might infer more than he insists upon, yet we cannot establish his speculations as positively as those of the Pythagoreans. This famous sect of philosophers arrived at some results which would prove fatal to the opinion of those who regarded them, till now, as mere hybrids of vague moralists and mad mathematicians. I am, at least, driven to the conclusion that they believed the interior of our planet to be a fiery sphere,—being a theory which bespeaks, at the first sight, an irrevocable affinity to the modern tenets of "*central heat,*" "*central fire,*" "*melted, fusible state of the interior of our globe.*" The Pyriphlegethon, known, as we are told by Olympiodorus, to Orpheus, and vindicated by the 'Phædo' of Plato to be the reservoir of lava, "οὗ καὶ οἱ ῥύακες ἀποσπάσματα ἀναφυσῶσιν, ὅπῃ ἂν τύχωσι τῆς γῆς," was unquestionably the result of the same efforts which attained, at length, in Pythagorean minds the "μέσον πῦρ:" for a passage in the pseudo-Aristotelian 'Θαυμάσια ἀκούσματα' informs us that a thermal spring of Italy was so named by the people of the country—a circumstance by which we are driven to the belief that this denomination itself must not only have been a mythological, but also a geological one. The "μέσον πῦρ" has been till now conceived by men of science astronomically, and has afforded, even thus, an object of outrageous dispute. Formerly it was almost generally admitted that this "central fire" meant nothing else than the sun; then it was contrasted to our cosmical luminary, and collocated as a fiery cube into the centre of the whole universe. And those who think so may find corroboration of their conjectures in the testimony of Aristotle himself; for such were the teachings he gave upon the subject in the second book of his 'Περὶ οὐρανοῦ.' But those who have not forgotten the words of the Platonic dialogue, as to some subterranean reservoir of lava, will, when reading the commentary of Simplicius on the same passage of the Stagirite, decide in a quite different manner. They will be told there by Simplicius, "So does he recount the tenets of the Pythagoreans; those, however, who have a better information (οἱ δὲ γνησιώτερον μετασχόντες) place the fire into the interior of the earth as a creative power to vivify thence the whole earth, and to reimplace the cooling by new heat." Hearing this, they will exclaim that in the present case the commentator must be right and the philosopher wrong —that the "μέσον πῦρ" must have been really meant, by the more profound of the Pythagorean sect, to be a mass of fire filling up the interior of our planet! Yes, certainly so; the geologist has made, on perusing that remarkable passage in the commentator, a discovery of great weight, which the philologist may support with the following arguments. A geological central fire might be accepted as a Greek scientific dogma hereafter by the historian of human knowledge, because not only Plato, influenced at the time he wrote his 'Φαίδων' by Pythagorean wisdom, shows himself in this dialogue to have aimed at some great final cause for volcanic phenomena whilst assuming his "πυριφλεγέθων," but we also meet with other efforts of this kind in Greek literature, as, *e. g.*, in the description Æschylus gives of Typhoëus, whom he makes to reach from Cumæ to the Isle of Sicily—efforts, in short, to justify ætiologically a character of volcanic phenomena more comprehensive than local,—because Empedocles, equally known as an ardent geologist (as we shall see in the sequel) and a resolute volcanist, has been attested by Athenæus, Gellius, Hierocles, Chalcidius, Syrianus, Johannes Philoponus, Philostratus, Cedrenus, Suidas, and the scholiast of Horatius to have received Pythagorean education—nay, by Timæus, Alcidamas, Eudocia, Tzetzes, the scholiast of Hermogenes, and pseudo-Origenes to have even received instruction from Pythagoras himself—Empedocles, he whose "*πολλὰ πυρὰ*" (his own term from the '*Περὶ φύσιος*') "*ἔνερθ' ὕδεος*" (others read *οὔδεος*), as interpreted by the Proclean remark, "*ὑπὸ γῇ ῥύακες πυρός*," seems, at the very first sight, to mean nothing else than "subterranean fire," or, according to the other reading, "submarine," most similar both with regard to its material conditions and its purpose to the Pythagorean "*μέσον πῦρ*,"—because the assumption of such a Greek hypothesis would facilitate the explanation of the much vexed question of the "*ἐκπύρωσις*," it being otherwise a matter of controversy from whence ought to come the fire which was at the close of the Great Year to destroy, in the eyes of many natural philosophers ignoring the infinite fiery ether beyond the starry sphere, the configuration of things on the surface of our terrestrial globe; and, finally, such a geological central fire might be accepted as a Greek scientific dogma, because the report given by Heraclides Ponticus about Pythagorean tenets, or, in still better confirmation, the report given by the pseudo-Plutarchian '*Ἀρέσκοντα*' about the hypothesis which Heraclides Ponticus entertained, viz. "that our earth revolves like a wheel about its centre from west to east," furnishes us with even the manner of apprehension to which the part of that geological central fire was probably submitted. The nucleus of the earth appears therein as an independent globe around which the real earth, being in this case a hollow sphere, was supposed to move—a supposition we may easily understand if we take for granted that the nucleus has been fictioned as a fiery mass. Now, Heraclides of Pontus was ever renowned to have been conversant with Pythagoraics; so *e.g.* he is attested to have written a history of the philosophy of this school: he might thence also understand what he meant by this "motion around the centre;" and if neither 'Placita' nor Simplicius (De Cœl. fol. 132 cod. Cocs., 166 Brand., 505. Anon. schol.) determine more particularly the nature of this "*μέσον*" of the earth, thence it does not yet by any means follow that he had not at all the "*μέσον πῦρ*," the "*πῦρ ἐν κέντρῳ*," in his mind; for we may ascribe that deficiency to the incomplete preservation of those sources.

In favour of these evidences we then declare that what the Pythagoreans called "*μέσον πῦρ*," "*πῦρ ἐν κέντρῳ*," "*Ζανὸς πύργον*" or "*ἑστίαν*" was nothing else but the fiery nucleus of our earth, analogous to that central fire believed in, from the transcendental writer of the 'Protogæa' to Elie de Beaumont (the mathematicians, the Neptunists, and the school of Sir Charles Lyell excepted), by certainly, on the Continent, the majority of geologists. The objections which could be raised against my arguments are of no serious significance. Heraclides of Pontus is surely an impertinent liar, who would make out, as a means of persuasion, men to have fallen down from the moon; but as to matter of science, it were difficult to impeach him successfully of imposture. The author of the 'Kosmische Systeme' (Prof. Gruppe of Berlin) terms this authority a pitiable plagiarist, who would have damnified the Platonic heritage merely because he has not been able to withstand the invectives urged against that somewhat strange "μέσον πῦρ:" the Berlin scholar terms Heraclides a plagiarist who, to save at least the memory of this pretended "fiery cube in the centre of the universe" from the scorn and contempt of those who have been informed, perhaps by the 'Periegetics' of Scylax of Caryanda, that there be on the southern hemisphere as little visible such a monstrous luminary as on our own, had precipitated it from its cosmical position downwards, fixed, or rather hidden it in subterranean vaults, and endowed it, by making the hollow terrestrial crust move around it, with a right of property in the doctrine of the rotation of the earth on her axis, a doctrine originally peculiar, in the eyes of Prof. Gruppe, to the 'Timæus' of Plato. This objection will appear immediately disarmed when we recollect that the ingenious German started from a point of view which may be styled, without any remorse, a presumptive one. He is anxious for his cherished idea, that Plato was the author of the doctrine both of the rotation of the earth on her axis, and of the revolution of our globe around the sun; and he becomes impatient when meeting a suggestion that all these were achievements of the Pythagoreans. Hence he does not appreciate the exclamation of the Agrigentine philosopher, "πολλὰ δ' ἔνερθ' ὔδεος [οὔδεος] πυρὰ καίεται," and, ignoring Proclus, who made this comment on the 'Φαίδων' of Plato, viz. that according to Empedocles there were beneath the earth torrents of fire (ῥύακες πυρός), constrains his own sound judgment to speak of these subterranean fires as of something like to an inferior hemisphere.

A second objection, of considerable purport, to my above assertion may be the high authority Aristotle holds with regard to astronomical history, an authority favoured by the despite which Pythagoreans were always subject to. Aristotle makes no mention of such a geological central fire (so will refine especially the philologist); how, then, could such a scheme of hypothetical extravagances be credited to writers living centuries after the great master? To this we answer that we deem the Stagirite no arbiter to the controversy. I shall illustrate the deficiency of his literary resources, in my fifth chapter, by the case of the famous "ὀρυκτοὶ ἰχθύες," wherein will become obvious his blasphemy: whilst Xenophanes has already recognized the hoary relics of past creations in those fossils of Melite, Paros, and Syracussæ, whilst Empedocles reconstructed his "βουγενῆ ἀνδρόπρωρα" and "εἰλίποδα κριόχηλα," and, moreover, whilst Anaximander founded his palæontological theory on piscine fossils imbedded in palæozoic strata, he (Aristotle) was not ashamed to teach that those fishes we know to be fossil "live motionless in the earth," or even to conjecture, as we may see from the writings of his most cherished pupil, Theophrastus the Eresian, that these fossils went astray into the interior of the earth, or, being born from fish-spawn left there in the growth of the earth, became themselves earthy! If, then, we hear that he ignored such systems respecting the history of our planet, might we not infer from this circumstance alone, that, in consequence of the fragility of Greek literary intercourse, he may have ignored in like manner the doctrine of the geological central fire? Did he not ignore at the same time another great achievement of classical antiquity, the hypothesis of the heliocentric system as proposed in the seventh book of the 'Νόμοι' of Plato, and as promulgated by the most learned of the Pythagoreans? Now I am neither a Platonic nor an Aristotelian; I will not revive the passion of pedants like Patrizzi; but my ambition is to examine the subject as a geologist. Therefore I do not lay stress upon the reproaches made by writers of both old and modern times against his celebrated luxury, exhibited, as we are told by classical authors, in his kitchen-utensils, but I lay stress chiefly on his having been educated a physician. This class of human society has laid, particularly in those times, claims respecting Natural investigation, to a scientific profoundness which they were not easily disposed to impart to unarmed philosophers. Hence his want of confidence, a trait which proved in his own zoological researches rather a virtue, but as to philosophical "διαδοχή" a veritable disaster. We may be, therefore, scarcely surprised if such a man, excluded from admiring the veiled treasures of so many antecedent Egyptian centuries (for in this respect his ignorance in comparison with the older "φυσιολόγοι" has been generally admitted)—if such a man, I say, having rejected the acquirements of preceding generations, nay, even those of his contemporaries, and having constructed most toilsomely the edifice of his own encyclopædical knowledge only from what he was himself able to handle, manifested resentment towards a more punctilious appreciation of such a detested sect as the Pythagoraic Confederation. The latter excited, owing to their social gravitation, the envy and hatred of philosophers more than their friendship. But when we review the critics, both philological and historical, who have attacked them, we can easily point out the internal causes which alienated, at the first glance, every sober scholar, and attracted only admirers of the fantastic. We only need remember the striking observations ascribed to Pythagoreans with regard to selenography and physical geography by writers of the period of decline, and the striking anatomical investigations attributed to them by writers of the "ἀκμή," and we shall generously confess that their mysterious phraseology and theatrical extravagance are traceable to other motives than to mere imposture or raving madness. What should we say, then, if we are driven to connect the discovery of the heliocentric system and that of the geological central fire with their enthusiasm? Surely, were human nature not as disposed to show pride of being enabled to put others in ecstasy, as circumspect and eager to show pride of having already arrived at a sufficient deadness to disdain the same feelings of others he very often almost religiously flaunted to raise, the philological critics, the most competent scholars upon the matter, would treat Pythagoraic pretensions with decidedly less aversion.

A third objection would probably come from those who overrate the popularity of hypotheses like that of the "ῥεῦμα οὐράνιον" as suggested by the 'Τίμαιος' of Plato, and as ascribed to Philolaus the "Stoic" by the ''Εκλογαὶ φυσικαί' of Stobæus. I believe it is too hazardous to infer from the belief of the above philosophers in the existence of cosmical or lunar waters, that the "ἐκπύρωσις" was, in the mind of all Greek cosmosophists, exclusively to be effected by the infinite fire beyond the fixed stars, as assumed by a considerable number of them. The "πυριφλεγέθων," the "τὸ ἐν βάθει πῦρ," would render such a "*deus ex machiná*," in the eyes of every rational thinker, superfluous, more especially the latter, which will support our above assertion (viz. that the doctrine of a geological central fire was already extant in classical antiquity) more strongly than any of the arguments enumerated. Those arguments were of no strictly geological utterance; they were even open, as we have seen, to some philological objections. But Plutarchus supplies me, in his 'Περὶ τοῦ πρώτου ψυχροῦ' with a mightier one; for the Chæronean informs modern geologists that the crystalline rocks were, according to the views of Empedocles, upheaved by subterranean fire. "As touching those rocks, crags, and cliffs which we see to appear out of the earth: Empedocles is of opinion that they were there set, driven up, sustained and supported by the violence of a certain boiling and swelling fire within the bowels of the earth." The "ἐμφανῆ," the "κρημνοί," the "σκόπελοι," the "πέτραι" substitute here what the moderns term Plutonic and Volcanic formations: the working geologist will adhere to this, perhaps, more rapidly than the philologist. Now the words which follow in the text:—"καὶ ἀνέχεσθαι διερειδόμενα φλεγμαίνοντος" (viz. "ὑπὸ τοῦ ἐν βάθει τῆς γῆς πυρός") corroborate everyone who is acquainted with the generalizations taught by the chthonological position of unstratified rocks, in the opinion that they bear an indisputable stamp of volcanistic tenets, and that the "τὸ ἐν βάθει τῆς γῆς πῦρ" to which they were referred bespeaks a final cause analogous to the modern geological central fire. If Empedocles was really deeply educated in Pythagoraic secret lore, this passage gives an immediate explanation to our above assertion; if not, the circumstance makes appear possible, nay, even highly probable (for those words preserved by Plutarchus shed a more philosophical light on) the tradition in conformity with which the haughty Agrigentinian buried himself into the crater of Etna.

Let us now look for a brief consolation for those students who have attempted till now to decipher the enigma of this "μέσον πῦρ." Prof. Röth, of Tübingen, was certainly a worthy scholar to pass sentence upon the question. Many years ago he risked an opinion, in his interesting work 'Geschichte unserer abendländischen Philosophie,' that, according to his views, Pythagoras was led by the phenomenon of eruptive volcanos to the hypothesis of the "μέσον πῦρ," of the so-called "πῦρ ἐν κέντρῳ." Yet the way in which he tends to explain the subject is far from being the right one. He understands the "ἀντίχθων" to be nothing else but the other hemisphere of our own earth, opposite to the one inhabited by the Greeks; and he imagines the "μέσον πῦρ" to be something like a geological central fire. Those, however, who study the function of both more earnestly, will soon perceive that such an arrangement would prove unsupportable even to mere common sense. For we must concede that the learned Tübingen Professor had either two terrestrial hemispheres connected with each other materially in mind when bringing forth his theory, or two hemispheres such as to hang independently in space from each other, possessing, nevertheless, some dynamical tie holding together such unconnected parts, and making up, in the eyes of a philosopher at least, the conceit of a sphere. Now, if he meant the first point of this alternative, he was apparently wrong in speculating thus; for, indeed, it has been universally taught that the Pythagoreans only took refuge in the fictive "ἀντίχθων" because they desired to reckon ten planets as constituents of their universe, and, were this arbitrary celestial body a hemisphere, that is, a part of the earth, the sum of their planets would amount only to nine, a conjecture incongruent with the report of Aristotle. Again, if he gave adherence to the second, he followed anew an erroneous path, because it is altogether impossible for a man of sound judgment to comprehend how such a central fire could be given as the final cause of volcanic phenomena, combined also, in the language of

Simplicius, "with the interior of the earth," when collocated into the interval of two different planets isolated in space and moving, without any rotation on their axes, around a fictitious common centre, the pretended centre of the material world: I ask, how could such a central fire give satisfaction to the exigencies for the sake of which it has been hypothetically called into existence? Might we not infer from the words suggested by later scholars to Heraclides Ponticus, that the μέσον πῦρ was rather a mass, probably a sphere or a cube of fire, supposed to have been intercepted by the hollow sphere of the tellurian crust? Might we not infer from these words rather that the "movement around her own centre" (περὶ τὸ ἴδιον αὐτῆς κέντρον), "and not on her axis, of the earth" is nothing else than a veritable rotation of the planet Earth?—a movement expressed by the hollow sphere of terrestrial crust revolving on an axis given by the respective diameter of the whole sphere, containing also that fatal "μέσον πῦρ" in its interior? However it may be, it becomes clear that the "μέσον πῦρ" and "ἀντίχθων" are in one and the same system incompatible. We must, then, admit that the different parts attributed to the functions of this central fire by different writers may be of the same description as the "ἀντίχθων," which, though of one foundation, represents in our eyes also different stages of the development of the same scientific idea. The Pythagoreans might have arrived from time to time at different levels of progress, or what I deem more probable, the author of this marvellous hypothesis, perhaps Pythagoras himself, having helped it laboriously through many intellectual vicissitudes, might have reserved to himself, or to the circle of a few selected pupils, the last link in the chain of this speculation, whilst he initiated others only into the penultimate, and the less worthy into the antecedent one. In this sense, then, we must admit that the "μέσον πῦρ" had possessed also its astronomical meaning, and the "ἀντίχθων" no serious one. But if the "cube of fire" in the centre of the universe, called into existence only, as Prof. Gruppe has shown with sufficient methodicity, that it should account for the apparent diurnal motion of the sphere of fixed stars, would suffer on its part in the same cosmological system (I like to style this system the penultimate link in the chain of that great acquirement) an "ἀντίχθων" in Prof. Röth's apprehension—that is, if such a "cube of fire in the centre of the universe" would supply the exigency of referring to the opposite hemisphere of our planet never witnessed by Greek adventurers, to conceal their deficient induction,—in that system which presented the last link, and in which, according to my researches, the "μέσον πῦρ" occupied the interior of the earth—in that system, I say, the "ἀντίχθων" was scarcely ever the opposite tellurian hemisphere, but perhaps an opaque body, analogous to those large meteors suggested by Sir John Lubbock and M. Petit the Director of the Toulouse Observatory, though I am not able to define whether the ancient discoverer was led to its assumption by the same evidence as these noble modern astronomers. It becomes clear to us, especially from the history of astronomy, that we are not to exert ourselves to reduce every scientific proposition denominated once Pythagoraic to the same uniform scheme. What a gap between the education of an Alcmæon, whose sun was nothing else than a disk, and that of those Pythagoreans who assumed, as we learn from the ''Αρέσκοντα,' that the moon was inhabited by animals fifteen times larger than terrestrial ones! Pythagoras might himself have furnished us, however, with the most striking illustration. It has been generally conceded that the geocentric system with the seven planets around the earth, as adopted by Aristotle and defended later by Ptolemæus, was confessed also by Pythagoras. Some scholars consider him as its author. Yet men of science, freed from prepossessed opinion, will hardly join with some philologists in terming the doctrine of the "μέσον πῦρ" a work of the epigones; nay, the path Plato traversed in his philosophical improvement from his youth, when he wrote the 'Phædrus,' to his venerable age, when he finished his 'Laws,' represents the steps forward made by Pythagoraic wisdom towards the attainment of something like our present heliocentric system—steps made as securely as gradually. I shall point out in a separate work evidences in favour of which the history of astronomy must, sooner or later, declare that Plato borrowed his views, higher than those of his Socrates in the dialogue, influenced apparently by Heraclitean impressions, as unfolded in his 'Phædo,' 'Republic,' 'Timæus,' and 'Laws,' successively, from Pythagoreans. The second part of the 'Phædrus,' the 'Phædo,' touches upon a system in which the earth does not revolve around the sun: in the former she joins perhaps to the Philolaic; in the latter our globe appears at first as "περιφερὴς οὖσα" in space. It is only in 'Timæus' that the earth commences to rotate on her axis, and in the 'Laws' that it performs a planetary revolution around the sun. The Nestor of classical philology may be opposed to Gruppe as regards the question of rotation; the words of Plato in the 'Laws' exclude any doubt as to the revolution at all. The great mathematician Jacobi assented to the discovery of Prof. Gruppe, viz. that the passage in which the Athenian "ξένος" tells Cleinias and Megillos that the Greeks are wrong in deeming the most rapid of planets to be the most backward one, and *vice versâ*, alludes indisputably to the heliocentric system, in addition to what has been remarked in the same dialogue, that "all planets describe but one orbit, though they seem to describe more than one." The mere philologist will think that Plato, who was never more than a metaphysician, a cultivator of æsthetics, and a political philosopher, could hardly give birth to this cosmical truth; as Gruppe tends to demonstrate, it is quite incredible that a dilettante, of whatever geometrical qualification, had originally called into existence a theory whose penultimate stage of development is attested to have belonged to sects and civilizations so closely allied with his tutors. Chalcidius informs us that the planets Mercury and Venus were ranged by some Pythagoreans before the sun—a system analogous to that adopted later by Tycho de Brahe, and known long ago already to Macrobius and Vitruvius, as well as in the mediæval age to the author of 'De Nuptiis Philologiæ et Mercurii.' And it is the presence of this stage of astronomical development which especially compels our recognition of those different levels above referred to in Pythagoraic lore; for, recollecting that the geocentric system, the system of planetary revolutions around the "Ἑστία," then the rotation of the earth on her axis as unfolded in the 'Timæus,' a dialogue founded by Plato exclusively on Pythogoraic "διαδοχή," and, again, this system, with Mercury and Venus revolving around the Sun, as leading finally to the heliocentric system itself promulgated by Plato in his old age, where his adhesion to the Pythagoraic became most obvious, are facts of striking importance, which will surely reconcile the learned public to my assertion respecting the geological central fire for the future.

I repeat, then, that the most learned of the Pythagoreans confessed the doctrine of a geological central fire, as well as that of the heliocentric system. Who was the discoverer? To this question we can give no reply. We have before spoken of Pythagoras as the communicator of these great theories, but we did so only because the general reception of scientific terms makes us suppose a formal unity of investigation within the Pythagoraic society. The philologists dare not call the university of these philosophers a sect, as the tenets cherished by them in other matters diverge almost individually. The uniformity, however, of the terms touching our present aims admits only thus a solution, if we adopt the idea that theories of such importance beamed forth from a common centre. We shall be satisfied when we see more clearly from whence these fatal attainments of ancient science came. As to the heliocentric system, I openly pronounce my opinion that the philologist is altogether incompetent to condemn those who dare to expect that it will be yet traced by hieroglyphical deciphering to the valley of the Nile, if not by cuneiform writings to the "Gate of the Sun." Macrobius styles that system from which there is only one step to the heliocentric (the system with Mercury and Venus around the Sun) an Egyptian one: those who imply an immediate solution of the problem by the aid of an Œnuphis or Sonchis from this transient passage would imply things certainly very hazardous, yet by no means so unphilosophical as they imply who show disappointment whenever a superiority of Nilotic or Chaldæan learning appears possible. A scholar, however, equally conversant with the lessons taught by geology and the positive results obtained by Ægyptologists, from Champollion to Lepsius or De Rougé, will always contend that deficiency of literary tradition should be distinguished from abundance of negative evidence.

I must declare, in addition to this, that I do not deem it probable that the doctrine of the geological central fire proceeded also from the Nilotics. Professor Lepsius suggests that the astronomical doctrine of a central fire was derived from Babylon. We learn from Olympiodorus that the Pyriphlegethon was already known to Orpheus, son of Œagreus; we have read, also, many uncritical hints on the connexion of Pythagoras with the philosophical inheritance of the Thracian lyrist.

Very little indeed is all we can say with regard to the probable origin of that hypothesis.

Anaxagoras, Democritus, Aristotle, &c., had in mind subterranean water, "*κοιλώματα*," "*ποταμῶν ὑποδοχαί*;" so had the majority of the Hellenes not exposed to volcanic troubles. The geological central fire may draw its origin exclusively from philosophers inhabiting the vicinity of some eruptive volcano.

I regret that I must oppose such a high classical scholar as Professor Böckh; yet, as regards this topic, I cannot overlook the merits of Professor Gruppe.

It was incessantly my endeavour substitute in the history of science, for vehement catastrophical factors, agents operating slowly in proportion to human expectation—fatally, nevertheless, in the lapse of enormous in-intervals of time—to substitute them in the like manner as a great Briton has substituted them in geology itself.

Professor Whewell says well that scientific discoveries cannot be communicated in secret, as were communicated certain arts or certain arcana. But this will hardly hold true for yon antiquity, in the centuries of which sacred prepossessions usurped such a malignant tyranny, when the law of gradual initiation so peculiarly pervaded every activity of civilization, and when mankind were as ambitious and as unconscientious as they are today.

CHAPTER II.

In my Second Chapter I treat of the so-called slow changes of the inorganic world. Strabo informs us in his 'Geographics' that there was a considerable number of authors who have collected facts of this description; and, in general, I feel justified in declaring that the Greeks have been surprisingly attentive as regards such phenomena. The alternation in the position of water and dry land was observed by them with high interest, but not so the fluctuations in level of continental masses, effected either by volcanic upheaval, by Neptunistic erosion, or by decomposition. As to the first, the vehement action of river-torrents, tearing out oaks and pines, is comprised in the comparison periods of the 9th Rhapsody of the Iliad, so that we might think we are being told of the Mississipi. The vehemence of rapid streams is depicted in the struggle of Achilleus with the elements in the 21st; but already in the 13th the assault of Hector is compared to the violence with which torrents pull out rocks; and in the 22nd there is mentioned a "ῥωχμὸς γαίης" produced by rainy water. The Amasean geographer endeavours to show that the growth Egypt annually received from the sedimentary deposits of the Nile was known to our poet. His "τεκμήριον" is the 358th verse of the 4th Rhapsody of the Odyssey. In the same Rhapsody we read how a rock (the seat of blaspheming Ajax) was split by the trident of Poseidaon. This splitting of rocks and of whole islands is to be met with repeatedly through the whole range of sacred literature in later ages. Callimachus, and the author of the 'Argonautics' might furnish us with illustrations. In the 6th of the same poem, Olympus is described, and ornamented with epitheta which place it in contrast with our earth, exposed, according to the poet, to decomposition. In the 8th Rhapsody, Alcinous expresses fears of the mountain with which Neptune was threatening to cover the town and chastise Phæacian audacity. Zeus has given also the advice to Poseidon to convert the boat into a vessel-like rock. The 13th repeats this fear of the above tyrant. In the 10th is mentioned a swimming isle, such as have been treated by ancient authors with far more trouble and anxiety than they really merited; it would be, therefore, superfluous to inquire circumstantially as to the utmost vicissitudes of the Cyanean Isles, of the Symplegades. We may term the scene beautiful in which Odysseus detects the prophecy about his death: "But when thou slayest the suitors in thy palace, either by deceit, or openly with sharp brass, then go, taking a well-fitted oar, until thou comest to those men who are not acquainted with crimson-cheeked ships, nor well-fitted oars, which also are wings to ships. But I will tell thee a very manifest sign, nor will it escape thee: when another traveller, now meeting thee, shall say that thou hast a winnowing-fan on thine illustrious shoulder, then at length having fixed thy well-fitted oar in the earth, and having offered beautiful sacrifices to King Neptune, a ram, and bull, and boar the mate of swine, return home, and offer up sacred hecatombs to the immortal gods, who possess the wide heaven, to all in order: but death will come upon thee away from the sea, gentle, very much such a one as will kill thee taken with gentle old age; and the people around thee will be happy; these things I tell thee true." So the 11th of the Odyssey. Could the imagined panting of waters on taking possession of all the continents be better shown in allegory than through the command of the infernal seer?

According to Strabo, Hesiodus knew the conversion of one of the Echinads, the Artemia, into dry land, and already he foretold the after-conversion of all.

Myrsilus has affirmed, in his 'Λεσβιακά,' that Antissa was once an isle; we are told by later authorities of its connexion with Mount Ida, in the same manner as Pithecussæ and Prochyta were with Mount Misenum, Capræa with Athenæum, Sicily with Rhegium, and Ossa with Mount Olympus. Strabo informs us that Ion of Chios has alluded to the avulsion of Eubœa from Bœotia in his lost satyral drama, the 'Omphale.' We might refer also to the cases of Echinus, Phalarus, Heraclea, Sperchius, Alope, Cyne, Opunt, Œon, Elatea, Agonis, Atalanta, if we knew whom the Amasean intended, when mentioning these data, by "τινες."

Nay, even the oracles have touched readily upon alluvial phenomena. The sedimentary approach of the Isle of Cyprus to Cilicia, as effected by the river Pyramus and alluded to by the above geographer, falls probably within the period with which I shall presently deal; similarly may have been known to those coeval with Alexander the obervers who drew a parallel between the operation of the Ister, Salmydessus, Thermodon, Iris, &c., and that of the Holy River. For Solon mentions the name of Canobus—a circumstance which excites our curiosity.

Ibycus, as we are assured by a scholiast of Pindar, celebrated by his song Ortygia, which had been formerly, according to him, an isle, but afterwards became "προσχωθεῖσα," a portion of dry land.

Pindar narrates in his 'Olympiacs' how the Isle of Rhodus emerged from the depths of the sea.

It may be inferred from the famous Heraclitean apophthegm, viz. that "nobody can twice enter the same river," that such a fluctuation of fluviatile beds must have been known to the Ephesian philosopher, although the achievements of the latter rely, as the historian of the Ionian philosophy has sufficiently shown, rather on metaphysical subtleties than on physical observation.

Pythagoras the Samian might have had also his own share in this part of study. Sir Charles Lyell has inserted the several data accumulated by Ovid in the 15th book of 'Metamorphoseon,' and conceded such a theory concerning the destruction and renovation of the earth to have been far more philosophical than any known version of the cosmogonies of Oriental or Egyptian sects. As Sir Charles has well remarked, some of the illustrations being derived from natural events which happened after the death of the Samian, *e.g.* the catastrophe of Helice and Buris, &c., we ought to regard the account as a true picture of the tenets of the Pythagorean school in the Augustan age; in the meanwhile we may take it for highly probable that the founder of this school had himself paid some attention to these terrestrial changes now in operation. The lamentable state of Pythagoraic literary "inheritance" permits me no other evidence than some phrases in the spurious work '*Περὶ τοῦ παντός*,' ascribed generally to Ocellus Lucanus. This Pythagorean forgery refers, amongst other matter, to those violent changes to which the parts of nature as a whole are liable, the sea taking at times its "*ἀνάχυσιν*" in another bed, and the dry land being sometimes enlarged, sometimes divided (*διισταμένη*) by the wind and water "*κρύβδην ἐπιφερόντων*," though a universal catastrophe would never befall our earth, according to the doctrine of the same pseudo-Ocellus. The Orphic hymns term Nature, amongst other matter, "*ἀλλοτριομορφοδίαιτε*," an epithet similar to those given to the earth by the Atharva Veda.

Anaxagoras the Clazomenean, being interrogated whether the Lampsacene mountains would ever become converted into sea, replied, according to the testimony of Diogenes Laertius, "Yes, if time lasts long enough."

Empedocles of Acragas is interpreted by Plutarchus, in the '*Αἰτίαι φυσικαί*,' to have alluded to decomposition by the line,

> "*ὅτι πάντων εἰσὶν ἀπόῤῥοιαι, ὅσσ' ἐγένοντο*,"

and particularly to the case of rocks exposed to marine waves.

We learn from the commentary of Alexander of Aphrodisias upon the 'Meteorologics' of Aristotle, that Democritus the Abderitan was of opinion that the sea is liable to a gradual exsiccation in consequence of perpetual exhalation—the world itself (that is, the universe) remaining, however, safe from any alteration.

Xanthus the Lydian is cited by Eratosthenes upon the question of fossil shells found imbedded in some strata, or on the top of mountains, distant several miles from the sea-shores. "Under the reign of Artaxerxes," says the logographer, "a great aridity caused the exsiccation of almost all rivers, inland seas, and wells." He drew also, from his knowledge of shell-like (κογχυλιώδεις) stones (λίθους) (or fossilized shells), and ctenodean as well as cheramydean types (τυπώματα), and from knowing also an inland sea (λιμνοθάλασσαν) in Armenia, and in Mattiena, as well as in Inferior Phrygia, the conclusion that the plains were once covered by water (literally, "the plains became once a sea"). Now the different codd. have instead of "κογχυλιώδεις," according to Casaubonus, "λίθους τε καὶ κογχύλια," others, again, "λίθον τε κογχυλιώδη." Prof. Lassaulx translates but "muschel- und kammähnlichen Versteinerungen." On my part, I am rather inclined to assume that the Lydian intended here to transmit the memory of individual fossils, than of some portions of the stratified series bearing such vestiges, as the Muschelkalk, &c. In the sequel to this account, I shall treat of this passage from a palæontological point of view.

The acute remarks of Herodotus on the alluvial type of Egypt are well known. In the second book of his History we find the following excursus. "They" (the priests) "recounted then that Menes was the first among the human kings of Egypt, under the reign of whom the whole of Egypt was, the Theban district excepted, a morass, so that there was nothing seen of all that now lies below Lake Mœris: the journey to this lake up the river from the sea amounts to seven days. I ought to add also what they said about the land. It is surely obvious, though a person, being a man of common sense, had heard nothing, but only seen that the Egypt navigated by the Greeks is a newly acquired portion of the Egyptian land, and a gift from the river; moreover all that extends a three days' journey above this lake, of which the priests did not speak in such a manner, is of the same kind. Egypt has a structure of soil of this description. If the plumb-line be dropped from shipboard at a distance of a day's journey from the continent, the mud brought up this way will testify that you find yourself in 11 fathoms water; from this we might infer so far that there exists an alluvial sediment." And again, "The land above mentioned appeared for the most part, as stated by the priests, to have been newly acquired to Egypt. For that portion betwixt those mountains beyond the town of Memphis seemed to me to have been once a bay, like as were the environs of Ilium and Teuthrania, or of Ephesus and the plain of Mæander, as far as one may compare these little things to the great ones. For there is none amongst the rivers which have adaggerated the above countries worthy of comparison, as regards measure, with a single mouth of the Nile; and yet the Nile has five such mouths! There are, indeed, besides those I would mention, a great quantity of rivers which, without attaining a grandeur like the Nile, have already performed great tasks; amongst others, the Achelous, running through Acarnania, has, where it joins the sea, already converted half of the Echinadic Isles into dry land. Arabia, not far from Egypt, has a bay also which branches from the so-called Erythræan Sea. How long and broad this bay is, I shall now describe. The length requires, from the innermost point to the broad sea, a forty days' rowing; in its greatest breadth, the rowing of half a day. There is high and low water on the same day. Even such a bay was Egypt, according to my view, once; one bay stretching, I mean, from the Northern Sea towards Æthiopia; the other, the Arabian (upon which I rely), from the south towards Syria: both bays nearly meet together by their inlets; they have almost perforated their recesses. If now the Nile were once to direct his waters into this Arabian bay, what is there to prevent the filling up of the whole bay with sediment in an interval of 20,000 years, by the alluvial force of the river? I expect, moreover, the bay would be filled up within 10,000. Could, then, in the infinite lapse of time which preceded me, such a bay or even a larger one, not have been filled up by a river so great and operating so mightily? I believe therefore what I have been told of Egypt, and am fully convinced of it, because Egypt projects beyond the land converging, because there are shells to be found on the mountains, because the soil ejects salt-particles which affect even the Pyramids (the mountain at the upper end of Memphis is the sole containing sand), because Egypt is neither analogous to the neighbouring Arabia, nor to Libya, nor to Syria (for the Syrians dwell on the coast of Arabia), but it has a black and crumbling soil, viz. fen and mud, brought down by the river from Æthiopia. The soil of Libya is, on the contrary, as is well known, more reddish and sandy, the Arabian and Syrian more clayey and also flinty. The priests told me about this land another important proof, viz. that under the reign of King Mœris the river, if rising at least up to eight cubits, laid Egypt below Memphis under water. And Mœris has not yet been dead 900 years, as I have heard from the priests. Now, however, if the stream rises not sixteen or at least fifteen cubits, it cannot overflow and inundate the land. And so might once the land of those Egyptians who live below Lake Mœris, especially of the inhabitants of the so-called Delta, remain uninundated, if the soil continues to grow in height, in the same ratio; and then might befall the Egyptians themselves what they assert would befall the Greeks." And again, "If we should adopt the views of the Ionians, as regards Egypt, who affirm the Delta only to be the true Egypt, which extends along the sea from the so-called Perseus-Tower to the Pelusian Tarichæa—a dimension of forty schœnes—and which again from the sea unto the continent extends to the city of Cercasorus, where the Nile assúmes two directions, the one towards Pelusium and the other towards Canobus, the rest of Egypt being partly Libyan, partly Arabian land,—if we adopted, I say, these views of the Ionians, we could in that case demonstrate that the Egyptians possessed formerly no land of their own. The Delta, at least, has been formed by alluvium, as the Egyptians themselves confess and as it appears to me; this land has only recently, so to say, come to light. If, then, they have not even had a land, how came they to teach that they were the first men? In this case, they ought not to take refuge in the experiment of ascertaining what language children will first utter. I think, nevertheless, the Egyptians had no coeval origin with what the Ionians called the Delta, but that they have existed as long as mankind have: it might have been the case that as the land acquired this protuberance, many of the inhabitants had preferred to stay behind, others, again, to descend by little and little. Once it was only Thebes which has been named Egypt, having a circumference of 6120 stades." Herodotus expresses in like manner his views about Thessalia, describing the country as at one time but a large lake. Both Strabo and Seneca quote this assumption.

Thucydides refers in his 3rd book to the changes effected by sismal action. "In Eubœan Orobiæ the sea, having retired from what was then the line of coast, and afterwards returned with a great swell, invaded a portion of the city, and partly inundated it, though it also partly subsided; and so that is now sea which was before land, about this period, when the earthquakes were so prevalent. It also destroyed the inhabitants, excepting such as could run up first to the higher parts of the city. There was a similar inundation, too, at Atalanta, the island off the Opuntian Locri, which carried away a part of the fort built by the Athenians, and wrecked one of two ships that were drawn up on the beach. At Peparethus, too, there was a retreat of the sea, though no inundation followed; and an earthquake threw down a part of the wall, with the townhall, and a few houses besides. The cause of this, in my own opinion, is, that where the shock of the earthquake has been most violent, there it drives the sea back, and this suddenly coming on again with a violent rush causes the inundation. But without an earthquake I do not think that such an occurrence would ever happen." The same historian of the Peloponnesian War says in his 2nd book, "Opposite to Œniadæ lie most of the islands called Echinades, close to the mouths of the Achelous; so that the river, being so large, continually forms depositions round them, and some of the islands have been joined to the continent, as I expect will be the case with all of them in no long period of time. For the stream is strong, deep, and turbid, and the islands are thick together, and mutually serve to collect the alluvium so as to prevent its being dispersed,—as they lie in alternating rows, not in one line, and the stream has no free passage into the open sea. They are uninhabited, and of no great extent. There is a report which I may also mention, that when Alcmæon, son of Amphiaraus, was wandering about after the murder of his mother, Apollo directed him by an oracle to inhabit this region, by suggesting to him that he would have no release from his terrors till he should discover and inhabit a country which had not yet been seen by the sun, nor existed as land, at the time he slew his mother, since all the rest of the earth was polluted by him. He was perplexed, they say, by such a command, but at length observed this alluvial deposition of the Achelous, and thought that sufficient to support life might have been thrown up during the long period that he had been a wanderer since killing his mother. Accordingly he settled in the parts about Œniadæ, and became powerful, and left the name to the country from his son Acarnan. Such is the account we have received respecting Alcmæon." Æschylus, to return to the poets, seems to have been prompt in the observance of changes acting slowly, but, in the lapse of ages, decisively. In 'Prometheus Bound' he suggests to the Titan the following words: "This mother, the earth, had foretold him on many occasions that the father of Zeus will be neither by rude force nor by fraud able to save his throne from utter decay." Prometheus terms the marine caverns of the god Oceanus "*αὐτόκτιτα.*" The poet was certainly aware of the phenomenon of alluvial formations; in the tragedies, however, which had not to suffer extremely the cruelty of time and have come down to us in a better aspect, we meet no other evidence of this kind than such expressions as "*ψαμμίας ἀκτᾶς*" in 'Agamemnon,' and "*Σαρπηδόνων χῶμα πολυψάμαθον*" in the '*Ἱκετίδες.*'

Sophocles alludes slightly to the action of rivers in his 'Antigone' and 'Œdipus Coloneus.' In '*Αἴας μαστιγοφόρος*' is perhaps a latent allegory in the words "*ἐς βυθὸν πεσεῖν,*" referable, not improbably, to the fate of some cities in Greece buried into the abysses of the sea. In 'Philoctetes,' the exclamation "*Ὦ καταῤῥῶγες πέτραι*" shows that the poet observed what modern geologists call decomposition.

Euripides touches upon the "*Ἐχίνας νήσους,*" which he styles "*ναυβάταις ἀπροσφόρους.*"

Aristophanes brings to the scene the question of the pretended increase of the sea, or rather alleges the Democritean doctrine above referred to. "Is the sea now larger than it was before?" asks one of the *πρόσωπα.* "It were unjust," replies the other, "if the case was such by the aid of rivers, and yet thou couldst not increase thy money!" From the 'Birds,' we learn Prodicus reflected on the nature or origin of rivers, a subject so dear to Greek caprice and imagination.

All that Plato says in his 'Phædo' furnishes us only with the affirmation that he might have seriously mused upon the geological effects of decomposition. "This earth is throughout corrupt" (διεφθαρμένα and καταβεβρωμένα); "not only the rocks" (λίθοι), "but also the whole place" (τόπος) (inhabited world), "as well as in the sea the things are all devoured by the ἅλμη." Then he begins to dream of the real earth, in his ideal nonsense, of an earth where the rocks are not devoured, but remain pure, and neither "κατεδηδεσμένοι" nor "διεφθαρμένοι" as here "ὑπὸ σηπεδόνος καὶ ἅλμης ὑπὸ τῶν δεῦρο ξυνεῤῥυηκότων."

Besides the above-enumerated authors, there were certainly a great number of others who have contributed, for the most part of course unwillingly, or at least unconsciously, to the foundation of geology, by collecting data of modern changes within the range of their own observation. Anteriorly to Aristotle much might have been observed; some of the alluvial phenomena noticed by Pliny in the second book of his 'Natural History' might have been handed down by pre-Alexandrine writers. To the effects of avulsion the Roman refers: "Namque et hoc modo insulas rerum natura fecit. Avellit Siciliam Italiæ, Cyprum Syriæ, Eubœam Bœotiæ, Eubœæ Atalantem et Mærim, Besbicum Bithyniæ, Leucosiam Sirenum promontorio." This paragraph excited the interest also of Servius, ad Vergilii Æneida, ix. 715, and the scholiast of Lucanus, v. 101. As to those of "πρόσχωσις," again, he continues, "Rursus abstulit insulas mari iunxitque terris, Antissam Lesbo, Zephyrium Halicarnaso, Æthusam Myndo, Dromiscon et Pernen Mileto, Narthecusam Parthenio promontorio. Syrien Ephesus in mediterraneo habet, Derasidas et Sophoniam vicinam ei Magnesia. Epidaurus et Oricum insulæ esse desierunt. In totum abstulit terras, primum omnium ubi Atlanticum mare est, si Platoni credimus, immenso spatio; mox interno, quæ videmus hodie, mersam Acarnaniam Ambracio sinu, Achaïam Corinthio, Europam Asiamque Propontide et Ponto. Ad hoc perrupit mare Leucada, Antirrhium, Hellespontum, Bosporos duos." As to decomposition, Pliny adds the following remarks: "Atque ut sinus et stagna prætercam, ipsa se comest terra: devoravit Cibotum altissimum montem cum oppido Curite, Sipylum in Magnesia et prius in eodem loco clarissimam urbem quæ Tantalis vocabatur, Galenes et Galames urbium in Phœnice agros cum ipsis, Rhegium Æthiopiæ iugum excelsissimum, tamquam non infida grassarentur et litora." In the subsequent chapter, the same author touches the phenomenon called by the Greeks "κῦμα": "Pyrrham et Antissam circa Mæotim pontus abstulit, Helicen et Buram sinus Corinthius, quarum vestigia in alto adparent. Ex insula Ceæ amplius triginta millia passuum abrupta subito cum plurumis mortalibus; rapuit et in Sicilia dimidiam Tyndarida urbem ac quidquid ab Italia deest, similiter in Bœotia Eleusina." However it may be, one datum in the Roman 'Natural History' is unquestionably due to pre-Alexandrine "*μεταρσιολεσχία*," and this is with regard to Pithecussæ. In chapter 88 of the same book, Pliny deals with some new isles upheaved by volcanic forces, so, amongst other matter, with that island which emerged in the third year of the 163rd Olympiad in the Tuscan Bay, "flagrans hæc violento cum flatu;" and here he mentions the above isles, "Sic et Pithecussas in Campano sinu ferunt ortas." We shall see, in our first appendix, that Typhoëus has been related by the Lerian Pherecydes to have escaped from Mount Caucasus, and been buried under those Italian isles; "Mox in his" (the Pithecussæ) "montem Epopon, cùm repente flamma ex eo emicuisset, campestri æquatum planitie." An event of later epoch, as well as the immersion of Prochyte, Thera, Therasia, &c., Caius Secundus speaks about. Among the foreign writers from whom he had taken the matter of his second book, he enumerates Plato, Hipparchus, Timæus, Sosigenes, Petosiris, Necepsus—the Pythagoreans Posidonius, Anaximander, Epigenes—the Gnomonists, Euclide, Cœranus the Philosopher, Eudoxus, Democritus, Critodemus, Thrasyllus, Serapion, Dicæarchus, Archimedes, Onesicritus, Eratosthenes, Pytheas, Herodotus, Aristotle, Ctesias, Artemidorus the Ephesian, Isidorus the Characean, and Theopompus.

The story of the 'Atlantis' is far from being the fiction of Plato; it had been started by other pre-Alexandrine writers already in the time of Solon, or, as we are entitled to judge from the name the great Athenian legislator gave to his lost didactic poem, by the latter himself. A considerable number of philosophers were already puzzled by this geologico-geographical enigma, from Bacon, Lord Verulam, down to the inquietude of modern German archæologists. I confess my deficiency to solve the difficulty. Before putting forth, nevertheless, the material yet extant about the subject in question in my forthcoming larger work, let me at present remark that all that has been laid down as to geological phenomena in 'Timæus' or 'Critias' was surely acquired by Pythagorean or Nilotic intercourse, and not by independent observation, or at least not by self-reliant physical investigation. The Byzantine has well characterized our philosopher when stating that he "*ἀεὶ θεολογῶν φυσιολογεῖ*," that he endeavours to obtain a knowledge of nature by the aid of metaphysics. We shall see in the sequel of the present work how little is due to real Platonic merits in cosmical inquiry.

Nor, as regards the whole of Aristotelian wisdom, can we join the ravishment of naturalists engaged in other branches of science, when we regard what the Stagirite has done in favour of geology. I shall point out more particularly, upon another occasion, how faintly that remarkable zoologist and wondrous polyhistor felt himself concerned by the past changes of our planet. But the last chapter in the first book of his 'Meteorologics' would alone be sufficient to secure for his name immortality, even had he not accumulated in his various other physical, metaphysical, and ethical writings such vast tokens of genius. Indeed, the methodological economy of the work 'Μετεωρολογικῶν' admits no evasion of the conclusion that the changes now in operation of the inorganic world were introduced here by Aristotle merely for the purpose of what approaches really the scope of modern meteorology. Nor even could one meet here with the strict tendencies of physical geography: yet, as a proof both of sagacity and profundity on the part of the Stagirite, as a memorandum of classical antiquity with regard to facts on which we have been for some fifty years, perhaps, accustomed to base our own pride and decipher Greek imbecility, the chapter proves highly instructive, earnestly marvellous. "Not always the same places of the earth are covered by water or are dry, but they alternate according to the origin or deficiency of rivers." So Aristotle, after having finished his treatise on winds and rivers, begins his fervid oratorical strain. "Here," he continues, "this happens in a certain order, and is liable in the lapse of determined periods to repetition. The cause of this consists in the circumstance that the interior of the earth has, not less than the bodies of the animal or vegetable kingdom, its own prime (ἀκμὴ) and decay (γῆρας). The earth differs only from the latter in such changes through cold or heat befalling its parts only, and not the whole simultaneously. It is, however, in both cases the sun and his motion that gives birth to an alteration. Hence some places abound during certain intervals of time with water, then they exsiccate and become old: others again become vivified (that is, they become "ἔνυδροι," aqueous), and thus cease to be, gradually, dry ground. It is a natural consequence of the exsiccation of certain countries, that the springs should disappear, that the rivers should first abate and then dry up totally. Now, as the rivers relinquish their channels, disappearing in one place and being reborn in another, the sea must also change its position; for where it was not supported by the discharge of rivers, there it ought to become dry, and where it received river-water in great redundance, there it should produce inundations (λιμνάζειν). But the changes of the earth" (or, literally, "the whole natural development about the earth," "πᾶσαν τὴν φυσικὴν τὴν περὶ τὴν γῆν γένεσιν") "are so slow in comparison to the duration of our lives" (literally, "by little and little"; for, though ἐκ προσαγωγῆς means, in conformity with Greek idiom, in comparison, yet, reduced to its etymological elements, this term might express also the soft, the gentle manner of the changes above alluded to; and the geologist will be entitled to prefer such an interpretation likewise, as the Ferrara Jesuit Nicolaus Cabeus has translated it by "per successionem," and as the preposition "πρὸϲ" before "τὴν ἡμετέραν ζωὴν" renders the repetition of the idea of comparison altogether superfluous), "and grow sensible only in so stupendous intervals of time that they are overlooked, and nations are wholly destroyed and laid in ruins before these permutations from their very epoch to their termination could be saved from oblivion. The greatest catastrophes which ordinarily befall mankind, and the most rapid, are wars, epidemics, and sterility; then the migrations of people become forgotten, for the population partly relinquishes their native home, partly remains there till the soil is no more capable of sustaining them. Between that first point of emigration and the last one, very long periods generally intervene; so that people of the latter ages lose remembrance of the earlier events, and are unable ever to determine the exact epoch when the first settlement of nations took place on tracts of land freed from water and changed from a marshy nature into dry ground."

"Those, therefore, who first took possession of certain countries become forgotten; and equally extinct becomes the remembrance of the time and manner of their settlement. This is notably the case with Egypt, which apparently is becoming more and more dry, the whole country being covered with the alluvial deposit (πρόσχωσιϲ) of the Nile. The marshes being by little and little (κατὰ μικρὸν) converted into dry ground, the correspondingly gradual colonization of the neighbourhood and the length of time render the beginning unfelt. The mouths of the river, save the Canobian one, seem to be the handwork of man; and, of old, Egypt meant only Thebes. A proof is afforded by Homer, who is but of yesterday (πρόσφατοϲ) in comparison with such changes, and who mentions yon city as if Memphis had not yet existed at all, or as if the latter had not yet been so celebrated. This we ought to find quite natural. For the lower regions became later inhabited than the higher, the tracts nearer to the alluvial operation (προσχώσεωϲ) remaining longer in a marshy condition. The portions converted into dry land assume during this time a more flourishing character, while the formerly dry tract when superexsiccated deteriorates. So Argos and Mycene: the former was unfertile in the Trojan days, the latter having then its prime; now we see a quite contrary state of things. Larger tracts furnish us with similar analogies. Now, those who observe only the trifling details suppose the cause of such phenomena to be the revolution (change, μεταβολὴ) of the universe (τοῦ ὅλου), as if the heavens (οὐρανοῦ) would suffer a process of genetic development. Hence, the same suppose that the sea diminishes, being converted ever more into dry ground, and point out that more places are now dry than formerly. But they deceive themselves; for, if they would look about circumstantially, they would find that the sea had also encroached upon many and corresponding portions. But we ought not to believe that in reality the genetic development (γένεσιν) of the universe is the cause of this; for it were ridiculous to move the whole university of things (τὸ πᾶν) for the sake of petty and momentaneous alterations. The bulk of the earth and its size sinks into nothing when compared with the whole heavens. But we must acknowledge that the real cause of all these phenomena is this, that there returns, after the lapse of a predetermined interval of time (διὰ χρόνων ειμαρμένων), a great winter-time of a vast season, which one may liken with the common winter of the solar year. And this great winter of a great year is marked by a redundance of rain (ὑπερβολὴ ὄμβρων)—a catastrophe befalling not always the same tract of land, but having a changing circuit. Such a winter-time of flood was the so-called cataclysm of Deucalion, which swept over and was almost confined to the Hellenic region, especially about the ancient Hellas, that is, about Dodona and the Achelous, which has already often shifted its course: the Selloi dwelt there, and the people then called Graikoi, but now Hellenes. When now such a rain-excess occurs, it proves sufficient for a long time." [The Stagirite refers then to the magnitude of high places, to their spissitude and frigidity, as to the causes which were to effectuate the production of current water, &c., a reflection connected with his chapter on the nature of rivers and more probably interpolated by later paraphrasts. See Notes.] "Now, as it is necessary that the universe (τοῦ ὅλου) should suffer some change (μεταβολὴν), though not genetic development (γένεσιν), nor utter decay (φθορὰν), if the universe (τὸ πᾶν) is eternal (μένει), it follows that the same tracts of land may not be always covered by water, viz. sea or rivers, nor always be dry. This becomes evident from the simple fact that we call the Egyptians the oldest race of mankind, yet their country has been accumulated in the course of ages by the work of the river, as every one who looks at it will be convinced. The phenomena about the Erythræan Sea offer a sufficient token also. Sesostris first attempted to dig through, but he failed, finding the sea higher than the continent around. Darius recoiled also from the like performance. It is clear that one continuous sea has covered all these regions. Thence the country about the Ammonian Libya appears of a lower level and disproportionately more excavated (κοιλότερα), than the tract below: here happened an adaggeration and caused marshes (λίμναι) and dry ground. Afterwards the water left behind dried up; now there exists scarce any of it. The environs of Lake Mæotis have gained also so much through the sedimentary discharge of rivers (προσχώσει), that it must now be entered in much smaller boats than could be done sixty years ago. We can therefore find no difficulty in inferring from the antecedents, that, as were the majority of lakes in the beginning (καὶ τὸ πρῶτον), the Mæotian Lake is likewise the work of rivers, and that finally the whole must become dry. The Bosphorus also flows perpetually because of adaggeration: one could witness this with his own eyes. When the flood (ῥοῦς) made an interception from the side of Asia, the tract behind was left as a lake, although it became dry afterwards. Subsequently another interception was formed and another lake in its train; and this process repeated itself many times, whence it ought to assume in the lapse of time some fluviatile type. Finally also this will be converted into dry ground. It is therefore obvious that, as time never fails, and the universe is immortal, neither the Tanaïs nor the Nile can have flowed for ever. The places where they rise were once dry, for there is a limit to their operations; but there is none to time. So also of all other rivers; they spring up, and they perish; and the sea also continually deserts some lands and invades others. Again, the same tracts of the earth are not always seas or always continents, but every part changes its condition in the course of time."

The very aspect of the plan in which Aristotle seems to have brought forth his 'Μετεωρολογικῶν' differs, more than probably, from that in which, especially, the third and fourth books have come down to us; but this terse treatise of physico-geographical changes might lay claim, in our own view at least, to some better authenticity. Moreover these lines bespeak a decided contrivance to display an unquestionable eloquence rarely witnessed from the style of our most sober naturalist. He combats also the hypothesis of Democritus, who taught that the sea was kept in a perpetual process of decrease, and that it would finally be dissipated in the atmosphere. Aristotle objects that the sun returns to one part what he bereaves in another, of the remainders of the pretended "πρῶτον ὑγρόν." "No, the sea cannot exsiccate," says he in the second book of his 'Μετεωρολογικῶν': "it is only that it was inferred from the assumption that at present there appear more places to be dry than before: the case is not so in reality; for that happens periodically (κατὰ κύκλον), and it would be laughter-moving to put the heavens in motion for the sake of such trifling phenomena." He also condemns the poetical definition of Empedocles, naming the sea "a sweat of earth." In the same book he similarly alludes to the Pontus as being deeper than the Mæotis, to the Ægean as being deeper than the Pontus, to the Sicilian as being deeper than the Ægean, and to the Tyrrhenian and Sardinian as being the deepest among all seas. He bestows on the cause of the sea's bitterness a remarkable acuteness: and here, again, we feel ill-humoured to see how imprudently the Greeks often subordinated some of the vital questions of our human dignity to those altogether secondary. In the fragments of his work about the political institutions of certain commonwealths, the Stagirite connects, amongst other matter, the intervention of Demeter with the prevention of the Drepanian isle's (Cercyra's) being converted into dry land by the rivers emanating from the continent. This we learn from the scholiast of Apollonius the Rhodian.

The book '*Περὶ κόσμου*,' attributed commonly to the Stagirite, but more probably the work of Chrysippus, Apuleius, or of another writer of epigones of this kind, reechoes, too, some reflections upon these modern changes of inorganic nature. "Earthquakes have already torn to pieces many parts of the earth (*ἀνέῤῥηξαν*); rains (*ὄμβροι*) have already inundated it destructively; '*ἐπιδρομαὶ*' of waves and '*ἀναχωρήσεις*' have already often converted continents into sea and the sea into continents" ("tracts covered with water into dry ground," and *vice versâ*).

We have thus all these data at our disposal. The Greeks, then, were aware of all those gentle changes; they knew that when accumulated they were capable of modifying the whole physiognomy of things on the surface of our planet; they gave birth to the same philosophical romance, when meditating upon such phenomena, as the forgers of the tale of the Seven Sleepers of the Theodosian age. For the fifty-seven years of slumber spent by Epimenides in the cave were determined to produce the same results both in the objective aspect of the surrounding landscape and in the mind of the sleeper, the amazement of the newly appeared generation not excluded, with that period of 187 years of the genuine legend recorded by the historian of the "Decline," and with those still longer periods of miraculous dreaming extant in the fictions of Scandinavian and Mahometan tribes "from Bengal to Africa," as quoted by the ingenious author of the 'Principles,' or as latent yet in many ardent sighs of Hindoo poesy. I could, besides, add some versions of the 'Vita Sanctorum,' one of which is referred to the mountains of Buda, in Hungary. Excepting Anaxagoras, there was, however, none of the above Greeks who would have been guided to a geology by the mere observation of such modern changes. The references quoted are, perhaps, links in a far higher logical chain than either the paragraphs of the various "Corpora Iuris," when dealing with the title of avulsion, or the similar adagios of moral philosophers; yet the generic vicissitudes of the organic kingdoms appear altogether independent of such "modern changes;" the extinction of animal and vegetable types, and the introduction of new or the revival of the same old ones in the periodical "*διακόσμησις*," were always a result of catastrophes.

CHAPTER III.

As regards the question whether the Greeks did observe or not those slow changes in the organic world which convey to the modern scientific mind the idea of a "transmutation of species," or, more generally, which would, in the lapse of enormous intervals of time, account for the extinction of old and introduction of new animal and vegetable forms, as the different powers now in operation in the organic world are most reasonably supposed to prove fatal to the general configuration of our planet's surface, we can only say that all that we may find in the literary remains of authors of classical pre-Alexandrine date sinks into insignificance. Moreover naturalists versed in the philosophical characteristics of the Ancient Greek genius will easily see that an attempt to add a historical force to such a category, as one of the "modern changes of the organic world," in favour of Greek observation, or even investigation, would appear altogether futile. Sir Charles Lyell, when casting a glance on the estimation of fossils in those ancient days, in his celebrated 'Principles of Geology,' well says that "it is not impossible that the theory of equivocal generation might have engendered some indifference on this subject, and that a belief in the spontaneous production of living beings from the earth or corrupt matter, might have caused the organic world to appear so unstable and fluctuating, that phenomena indicative of former changes would not awaken intense curiosity." The same holds true, and even better, as regards those minute changes within the varieties of race, species, or genus.

Neither the idea of "species" nor that of "genus" having been established, it is of course natural to believe that changes in them were not remarked. The phraseology of Greek zoologists illustrates the case. The writer of the 'Θαυμάσια ἀκούσματα,' and other phlyacographers, speaks, for instance, of frogs which utter no voice, of mules fertile inter se; but he does not ask whether animals of such description, like these, yet different from them in such features, belong to common frogs or common mules at all. The same writer speaks also of several varieties of mice in Cyrene: so he mentions the "πλατυπρόσωπος," the "ἐχινώδης," &c. ones, he mentions "mice of Pontus" and "mice of Egypt," without feeling any motive at all to ask whether those animals which he stated to ruminate or to be so large, to be covered with hedgehog's-like hair and to go on two feet, were mice or not.

Now, not to touch upon the poetical licence, according to which, in

Pallene, men, having been nine times plunged into the Tritonian lake, were turned into birds, such fabulous generations as those from "ἀετῶν ἀγόνων" of a "ἁλιαίετος," from "ἁλιαίετος" of a "φήνη," from these of "περκνοὶ" and "γῦπες," from these of the "μεγάλοι γῦπες" (stated to remain at length ἄγονοι), as narrated by the pseudo-Aristotle, or, as the rumour that the claws of a crab-fish, when set in the earth, will produce scorpions, elucidate the state of matters sufficiently: where only so striking changes could awaken any attention of the public, or where such are believed by the naturalist himself credible, nay, even positive, there the question of the "Ægilops ovata" would never have been raised, nor the genetic vicissitudes of pigeons, &c., as expounded, for the sake of a theory of natural selection, by Darwin.

And it is not for the unsusceptibility of Greek observers, for they were ready to investigate questions as insignificant as, Why are the tears of wild boars sweet, but of stags and hinds saltish? or, Why does the date-tree only of all others arise archwise, and bend upwards when a weight is laid thereupon? or, again, Why is the flesh of those sheep which have been wolf-bitten tenderer, but their wool more subject to breed lice and vermin than others? It is not for the unsusceptibility of Greek observers, but the simple consequence of their own national philosophy.

That the so-called equivocal generation was supposed to go on in the organic world by the generality of Greeks, and by almost every philosopher, is a fact long ago acknowledged. Besides Hesiodus, who admits, as Röth and a learned English scholar, Charles Bruce, explain, that men were created by God, Pythagoras and his school seem to be the sole exception to the rule. Diogenes Laertius, at least, tells us in his eighth book on the "Life and Apophthegms of Philosophers," that Pythagoras taught "τὰ ζῶα γεννᾶσθαι ἐξ ἀλλήλων, ἀπὸ σπερμάτων· τὴν δ' ἐκ γῆς γένεσιν ἀδύνατον ὑφίστασθαι." To determine whether this hypothesis gave birth to Egyptian traditions, or not, lies at present altogether beyond our ken, even if it seems confirmed by the circumstance that Ovidius, who transcribes Pythagorean tenets, speaks also in his 'Metamorphoses' of seeds fallen from the heavens. For I cannot look upon the different reports, asserting that Parmenides, Anaxagoras, or anybody else indulged in an origin of animals, *e.g.*, of mankind, from the sun and moon (that is, of men from the former, and of women from the latter)—I cannot look upon such reports otherwise than with a certain predilection for symbolics or allegorics.

A classical passage for the Greek doctrine of the spontaneous generation of mankind Plato affords in his 'Menexenus,' where he concludes that men must have originated from the earth, because the latter produces crops of wheat and barley for their nourishment, no less than a mother furnishes her child with milk; and adds that women imitate nature in conception and parturition, and not *vice versâ.* Another refers to an origin from mud: so the apophthegms of Archelaus, the last Ionian philosopher, and the pretended teacher of Socrates, as communicated by the above biographer.

Aristotle asks, in his 'Problematics,' Why do some animals originate not only from each other, but also spontaneously; others only from each other, as, for instance, men and horses? The motivation is a very strange one:—"If not for other causes, perhaps therefore, that for some the time is short *τῆς γενέσεως.*"

Interesting is it to read also what he says about the "*γένεσις*" of animals "*ἔκ τινων συγκρινομένων*:" This spontaneous generation was attached, as regards human origins, so to say, to the memory of some primeval days: that is, neither Greek philosophical nor the Greek popular creed were ever prepared to point out their own contemporaries as those who obviously had emerged from the earth; but as regards the inferior subkingdoms of animal creation, it was believed to go on, successively and interruptedly. The giants Cecrops, Theseus, the "*σπαρτῶν γένος ἀνδρῶν,*" belonged all to the past, to the past of, as the poet says, "*παλαιγενέων ἀνθρώπων.*" We might add mammalia and birds, as we read that eagles, peacocks, doves, &c., were produced from the yelk. But to the origin of the classes of birds, reptiles, fishes, or even to the invertebrate divisions, no such confinement was made. Aristæus is recounted to have made the discovery that bees are bred out of the putrid bowels of calves. Later authors assume that hornets are bred from rotten horses; then snakes are produced from human marrow in sepulchres.

It is in this sense that Anacreon styles the grasshopper an "earth-born" ("*γηγενὴς*") and a "real philosopher."

It is in this sense that we may say that, according to Greek view, the work of "*γένεσις*" (we would write Creation), on the surface of our planet, was not yet accomplished. In connexion with these different epochs of genetic production, we cannot but remark that different centres of creation also enjoyed in Greek natural philosophy a most liberal value. Pausanias illustrates particularly the case when narrating to what places they did refer the very first appearance of some animals and plants. So we know that the first hooppoe presented itself, according to the popular creed, in the vicinity of the tomb of Tereus, the first ivy in Acharnæ, the flower of Ajax in the isle of Salamis, not to mention the legends about the origin of roses, lilies, &c.

Now, that the vulgar creed had no idea at all of the derival of species from a common stock becomes obvious from the circumstance that they assigned, not only to the first individual, but also to the second, a different origin. So an olive has been shown in the Academy at Athens, which was stated to have been the second produced by the earth of that kind,—a remark not very creditable to Greek knowledge, when the annual rings of the tree are examined, and in regard to the antiquity of the earth. This holds true also with respect to the origin of the human race. We have a considerable number of persons said to have been autochthones, persons of the most different countries and epochs. Especially the Athenians boasted of their autochthonous virginity. Isocrates, Demosthenes, and other orators bring this eulogy to a good issue. Now, in harmony with their scheme, all these autochthonous origins had been called into existence in epochs several hundreds or even thousands of years remote from each other; but when we read that Hesiodus and others had sung, according to Pausanias, Pandora as the first woman on earth, prior to whom there had been no other woman nor a virile sex, or when we read in the 'Politicus' of Plato something approximate to such ideas, we must consider only that the one mother whose children the Greek poets incessantly boasted themselves to be, was the great mother of gods, Earth herself, she to whom the "echo of the cymbal and the drum and the fifes and hum were sacred, and to whom the roar of wolves and tawny lions and the reechoing mountains offered a delight," on the hills of Arcadia as well as on the banks of Bramaputra,—that Plato's own words in the 'Menexenus' annihilate every other conjecture,—we must only consider that the excursion referred to by no means intends a doctrine similar to the one pair of sacred tradition, but partly a poetical amplification like that unfolded by Aristophanes (as introduced by Plato, to take vengeance on the author of 'the Clouds' for the memory of his cherished master, in his 'Symposium'), and partly a politico-pædagogical model the real existence of which not even to the forger himself seemed credible. These were the popular belief. The unity of the human race is entirely incompatible with a Hellenic point of view. Men of science cannot pay earnest attention to such tentatives where, in order to corroborate a pretended antique monogenistic hypothesis, they find quoted the verse of Pindar, "ἓν ἀνδρῶν, ἓν θεῶν γένος." There might certainly be traced an acute demarcation between the folkslore and the authentic theories of the "φυσικοί"; but there are neither any traits reminding us of Shemitics, nor of the "five races of men" adopted by the writer of the Atharva Veda; and as to the whole, Greek philosophy seems rather to have here brought forth a hypothesis of geographical aims. We often read in the fragments of the old philosophers, as their tenets, that in the beginning of the world the virile sex was created in the cold and the feminine in the warm zones. Particularly Parmenides confessed such a heresy, Parmenides, who had most probably read in the writings of the navigator Syclax of Caryanda some notice about the numerical preponderance of women in tropical, and yet more so in equatorial latitudes. I am seriously inclined to trace all such hypotheses, and even those superstitions favoured by Aristotle himself, and cultivated by many modern barbarian tribes, as to the fertilizing power of boreal winds, &c., to reflections on similar observations.

Even in our own age, it appears to be now generally admitted that unity of species does not involve unity of origin; in what, then, regards the relation, in the Greek view, of human races to each other and the other groups of the animal kingdom, we must refuse every startling generalization; for I am firmly of opinion that the whole question of the origin, development, transmutation, or extinction of human races, as dealt with by the greater part of ethnologists, is of a negative character, and has arisen from the reaction against a theological proposition. Had sacred tradition not awakened, say, the philosophical theme of the origin of mankind from one single pair, scientific investigators would have never accumulated around those points of view so many data of observation.

Now, concerning the coordination or subordination of relations of human races to those of animal categories, it is interesting to read what the Stagirite asks in his somewhat obscure work just named. "Why does man utter more voices (φωνὰς) than one, and the others one, though they are 'ἀδιάφορα τῷ εἴδει'?" Hence it might perhaps appear that the various races of men were not yet recognized by him to differ as the *Felis catus angorensis* differs from the *Felis brevicaudata* of Nippon, or from the *Felis domesticus cærulea* of Tobolsk, and their mewing, or as the bears of Kamtschatka differ from those of Tibet, of the East Indies, of the Sunda Isles, of Nepal, of Syria, of the United States, of Europe, of the Rocky Mountains, of the Andes, and their growling, in the estimation of our scientific age, although there were already spread in his days over Greece by logographers, as well as related by Pausanias, Ptolemæus, and Pliny, rumours about tailed men and other monstrous anthropoid beings, which might have served for an intermediate link in the chain between mankind and the lower orders of mammalia known to pre-Alexandrian antiquity.

To meditate upon the Royal Egyptian experiment, made in order to ascertain the primitive language, as recounted by the Halicarnassian historian, falls beyond the scope of the present essay,—the classification of Ephorus of Cyme, of Ammonius Saccas, of Dionysius Cassius, and of Rufus the Ephesian likewise; we can say, however, thus much: if even the ethnic horizon of the Greeks became enlarged after the conquests of Alexander, their genius still retained its former character.

In order to show what changes were observed by the Greeks, I adduce a few instances respecting the changes said to be effected, by drinking water, on quadrupeds. Hippocrates and others maintained this hypothesis. It becomes most obvious in the Aristotelian 'Problematics.' "Why do some of the animals," asks their author, "changing water, change also their colour (χρόας) and become similar to those insident there, as, for instance, the goats, while others not, as, *e.g.*, men?" The answer is wanting; but Theophrastus of Eresus believed, as we learn from Pliny's 'Natural History,' that men drinking from River Sybaris become more swarthy and hardy, with the hair curling, while those drinking from the river Crathis become fair, effeminate, with the hair straight, while sheep and cattle become there totally black, and here totally white. "And in general," continues Aristotle, "why do some change at all, others not? for instance, the raven does not change. And why *do not themselves, but their offspring change*? Perhaps because the young are weaker than the parents?"

Ctesias the Cnidian ascribed, in spite of all these pretended observations, the black (dark) colour of Hindoos, not to the action of solar rays, though the latter have been accused by Æschylus, Herodotus before him, by Theodectes of Phaselis, and a great many authors after him, of swarthening the skins of nations; but he ascribed it to nature, that is, he established a scheme of "permanence of type." However it be, we cannot share in the principles of such a kind possibly governing ancient controversy.

Finally, I will not overlook a doctrine which proves, at every step, so inherent in classical antiquity as that of a degeneration or deterioration of mankind. It was taught by their sacred poets as well as in their popular creed, by their historians as well as by their naturalists. The same doctrine might have arisen under different longitudes from a passionate examination of moral exigencies; but with the Greeks it has chiefly arisen from the misinterpretation of the fossil skeletons of huge extinct, *Pachydermata*. Entombed, as we shall see in the fifth chapter, by the ignorant people on the very top, they were found in metallic or stone sarcophages, which, being considered to be the relics of some envied ancestors, became the objects of religious veneration: hence the perverse succession of ages in Hesiod and Ovid.

CHAPTER IV.

The first question of importance which occurs to a student dealing with Greek knowledge as to the origin and development of our earth, or, speaking more scientifically, the changes it underwent in the past, would be, whether the Greeks made any aquaintance with that stratified cemetery where we now find entombed the organic remains of former creations. The truth is that philologists will not be able to point out in pre-Alexandrine Greek literary productions a fixed or technical designation of the notion of "*stratum.*" Poets call our earth "μελάμφυλλον," as Euripides; Pindarus and Æschylus utter, furthermore, this epithet as to Mount Etna. With the Hecabe of Euripides our earth is a mother of "black-winged" dreams. But such a poetical illustration, especially when we meet passages in old authors like that of Xanthus the Lydian, where the logograph expresses his strong conviction that the volcanic formations of the "κατακεκαυμένη" are the result of thunderbolts, will surely not encourage us to take for granted that these "earthy" "tellurian leaves" were coal-seams, or other layers or strata, not even if reminded by the later Theophrast of the coal-beds of which the Elean smiths had already made use. We draw, nevertheless, somewhat nearer on perusing a pseudo-Democritean fragment preserved by the Byzantine 'Γεωπονικά' and dealing with the spurious subject of hydrophantics. It is only so late as here that we meet the different terms "ἐδαφῶν," "διαφύσεις," and "συμφύσεις." The first we find translated in the same, we would say, official edition, "solorum," the second "straturas," the third "concretiones." A fourth one, "σύνοδοι τῆς γῆς," we find rendered thus, "terræ juncturæ." Now I can see with a considerable certainty that the "ἔδαφος" was to mean, on that occasion, at least, a stratum; for the pseudo-Democritean author continues, after mentioning the above terms, as follows:—"It is necessary to study their genera too. The soils of an argillous (ἀργιλλώδης) and pumiceous (κισσηρώδης) type and of a rough character contain in general no water. But we ought not to despair as to the glutinous (γλοιώδης), those of an igneous colour (πυρώδης), the luteous (πηλώδης), those of a black earthy substance (μελάγγεια), those which appear fat (λιπαρὰ), and those of a calculous strature (ψηφιδώδεις τε διαφύσεις ἔχοντα). As regards the calculous, they furnish us with water only when their position bespeaks no disturbance of the earthy strata (μὴ ἀνατεταραγμένα εἶναι ἐν τῇ γῇ), and when they inhere κατὰ πλάτος ἐμπεφυκότα as well as to the whole when the ἑτεροχρωματοῦντα τῆς γῆς abound in crusty (πλακώδεις) and dense (πυκνὰς) concretions (συμφύσεις). The junctions of the earth (σύνοδοι τῆς γῆς) are stored with 'ἀνόμοιαι συμφύσεις.' Rocks (πέτραι) afford water only when blackish (ὑπομελανίζοντες); they must be notwithstanding non 'varorum instar' ('μὴ κατὰ ἰόνθους') but having something of the foraminous (ἐχούσας τι πορῶδες). Water is contained also by the 'λευκήπειροι,' 'ὑπὸ ταῖς πτέρναις, ταῖς ἐν τοῖς ἐδάφεσιν ἐμπεφυκυίαις,' if they are spread over the soils we have just described. The anomalous concretions of rocks do likewise, if superincumbent to the mentioned 'κλίμασι.'" (This "κλίμασι" has been translated by the Latin text thus, "regionibus.") "As there are a great number of 'λιβάδες' and 'ἐπιπόλαιοι' to be met with in the black earth if the latter reunites at the same time these three other properties, viz. 'ψηφιδώδης,' 'πυκνή,' and 'γλοιώδης,' it will prove, of course, of indisputable advantage to dig 'ἑπόμενον ταῖς λιβάσιν.' By this method a considerable quantity of water might be arrived at. Not so with the 'ἀραιοῖς,' and 'πετρώδεσι,' where one ought to be glad if any spring at all is encountered." This remains then the only Greek fragment through which we come approximately to such stratigraphic results; for, unhappily, Xenophon, though he might with sufficient ease have touched upon the different layers in his treatise of husbandry, avoids every reference of this kind, save a slight one to arid and watery soils. That the above lines are not Democritean, at least not in their present shape, requires no further examination to prove. We might go further, we might even assert that the origin of the whole collection attributed generally to Cassianus Bassus is a mystery. But we have no evidence whatever to suggest that the frame itself of similar reflections based upon observation would prove altogether hostile to Abderitean philosophy. Varro and Columella yet knew the book of Democritus entitled "Περὶ γεωργίης," or "Γεωργικόν" (as emendated by Menagius and Meursius); Palladius no more. The latter makes use of fragments not to be met with in Cassianus Bassus: at that time some writings of Bolus Mendesius 'De re pecuaria' had already usurped Democritean authorship. That our fragment could be traced back to a higher antiquity than the epoch of Vindanius Anatolius I agree with Mullach in assuming. Perhaps Abu Baker Ben Vahsscia, whom we see quoted by Abu Zacharias Jahia Ben Mohamed Ben Ahmad, in his treatise of Agriculture, has witnessed the authenticity both of the 'Αἰτίαι ἐπίπεδοι,' the writing to which the illustrious German scholar just named attaches the merits of a geological observer, and that erroneously entitled by Diogenes Laertius "On Geometry" instead of "On Agriculture," from which the above hydrophantics may have been copied. However it be, we have no evidence at all that the crystalline, metamorphic and fossiliferous strata were at all observed or even investigated as distinct groups by Greek naturalists, anteriorly to the epoch of Alexander. We nevertheless cannot hesitate to take for granted that they had already some rough ideas of the autobiography of our planet; or, at least, we can demonstrate that this great autobiography cannot be regarded as a sealed book of whose existence those ancient philosophers were unaware. They have turned over its pages, though their deficiency of chemical and anatomical discipline did not allow them to decipher it. Direct proofs we have scarcely at our disposal beyond the following two reports.

Plutarchus the Chæronean tells us, as we saw above in the first Chapter, in his most spirited treatise of the 'Primitive Cold,' that according to Empedocles all the "ἐμφανῆ," all the "κρημνοὶ," all the "σκόπελοι" and "πέτραι" have in fact been *upheaved* by fire latent in the depth of our earth, "καὶ ἀνέχεσθαι διερειδόμενα φλεγμαίνοντος τοῦ ἐν βάθει τῆς γῆς πυρός." To translate exactly the above "ἐμφανῆ" etc. into the language of modern science would be altogether futile; in the sequel to the present work I shall attempt to give, under the auspices of both etymology and geology, some variances: yet every sober reader will, when acquainted with the first rough results of cursory geological observation, acknowledge that all these have necessarily denoted phenomena of crystalline rocks, *e. g.* of trachyte, basalt, or granite, as developed mostly in those regions the Acragantinian philosopher may have visited. What Aristotle referred to in his 'Problematics,' when treating of the origin of thermal springs, appears to have the same scope.

Xenophanes of Colophon is another philosopher to whom we find geological merits attributed. Origenes says in his 'Φιλοσοφούμενα,' that according to his views "there would happen" a "μίξις τῆς γῆς πρὸς θάλασσαν," "a mingling up or intermixture of earth with the sea, and in the lapse of time the earth should be solved by the fluid" (καὶ τῷ χρόνῳ ἀπὸ τοῦ ὑγροῦ λύεσθαι). In order to demonstrate this the Colophonian alluded to such evidences ("ἀποδείξεις"—somewhat emphatically sounds this τοιαύτας ἔχειν ἀποδείξεις in the text indeed) at his disposal, as shells found "ἐν μέσῃ γῇ," and on mountains. "In Syracuse," he said, "there have been found in the stone-pits (λατομίαις) the types of fish and phokes" (I restrict myself previously to adhere to the original Greek τύπος), "in Paros types of laurel in the depth of the rock (ἐν τῷ βάθει τοῦ λίθου), and in Melitos the πλάκας of almost all marine productions. And all these things may have been called into existence at the epoch when the universality of things were kept in a state of mud; and the types may have become desiccated in the mud" ("ταῦτα δέ φησι γενέσθαι, ὅτε πάντα ἐπηλώθησαν πάλαι, τὸν δὲ τύπον ἐν τῷ πηλῷ ξηρανθῆναι"). "All mankind were snatched away," continues the learned church-father in sketching the hypothesis of Xenophanes, "when the earth, set under the sea (*κατενεχθεῖσα εις τὴν θάλασσαν*), assumed the aggregationary condition of mud (*ὅταν πηλὸς γίνηται*); afterwards the genesis was to commence anew, and this destruction (*καταβάλλειν*) befall all the great cosmical periods of the universe." (Literally, "all the worlds," "*πᾶσι τοῖς κόσμοις γίνεσθαι καταβάλλειν.*") The same lineaments of hypothetics are given fragmentarily by Eusebius.

We can then frankly decide that the great founder of the Eleatic school had compiled his geological scheme from the observation of changes in physical geography, or rather from the examination of those conditions under which those organic remains seemed to have been imbedded in the vaults of the rocky strata, as surely as Empedocles was later led by the observation of volcanic phenomena to the assumption of his upheaval theory, above referred to, on the one hand, and to the dogma of a great cause of volcanic phenomena on the other. I shall return in the next chapter to the palæontological point of view of this remarkable passage: but it is to the inorganic formation of the Xenophanean earth alone that I feel anxious at present to draw the attention of the reader. The late Professor Lassaulx, of Munich, went so far as to identify the above hypothesis with the Neptunistical theory of earth, proposed by the able chemist J. N. Fuchs some seventeen years ago. I am satisfied with inferring from the authority of Origenes particularly, that Xenophanes, if he used the word "*κόσμος*" himself, and not the various polymathic anthologists, lexicographers, and grammarians alone, never could have denoted by it a universality of things coexistent in space, but always a universality of things successive to each other in time. By means of this supposition we easily get rid of the difficulties into which otherwise the mutual reconciliation of the records of Plutarchus (or at least a pseudo-Plutarchus), Galenus, Porphyrius, Stobæus, Theodoretus seems involved. His apophthegm "*ἓν τὸ πᾶν,*" expressing a unity of world, was so notorious, his whole philosophy leaning on an Eternal Immoveable Pantheistic Principle, so essentially connected with it, that to teach that he meant by the "*ἄπειροι κόσμοι ἐν τῷ ἀπείρῳ κατὰ πᾶσαν περιαγωγήν*" (*περίστασιν* pseudo-Plutarchus, Galen), in the language of the author of the '*Φυσικαὶ ἐκλογαί,*' somewhat like the one hundred and eighty-three worlds of the Himeraic Petron, or (lest we should condemn philosophers of whom we know but the name) somewhat like the scheme of other Grecian thinkers, who believed in inhabited planets, would be altogether arbitrary. Cousin, at least, adheres, in his most valuable 'Nouveaux Fragments,' to this opinion.

In the case of Anaximander, Anaximenes, Diogenes Apolloniates, Leucippus, Archelaus, and Democritus, we feel the necessity of the same interpretation: yet in no case could a geological tendency be more successfully demonstrated than in the case before us, in the case of Xenophanes. In my second chapter I have adduced as many observed changes of the physical geography of the terraqueous surface as are sufficient for suggesting that, if any coming accumulation during the lapse of long intervals of time had been estimated, some rough anticipation of Lyellian geology might have been certainly arrived at. We have found a partial reflection of this kind in Herodotus, who speculated upon the effect of the alluvial activity of the Nile in ten or twenty thousand years; on the other hand, we have seen Aristotle's striking remarks in favour of the alternation of dry land and water. The former had no occasion to enter the field of such investigation; the latter declared on many occasions that all that happens under the moon is worth of his contempt. Other philosophers keep a more silent behaviour on this subject—a circumstance from which we should for the most part rather infer that they did not geologize at all, or, if they uttered some alarming screams about the final burning of the universe, etc., they started from the transcendental scheme of astronomy of their own fancy. We read moreover in later accounts such fragments of cosmogonistics attributed to the old Pythogorean, Eleatic, or Ionic sects as, for example, that in the second book's sixth chapter of the ''Ἀρέσκοντα,' where the physical formation of the Empedoclean earth is described, amongst other matter, as forwarded by the "ἀναβλῦσαι" of water from the "ἄγαν περισφιγγομένης τῆς φορᾶς τῆς γῆς," or other passages where the notorious and at the same time apocryphal dogma of a "shifting of the cosmical axis" (also the dogma of the Gallic and other Druids) after the first establishing of things on our planet is alike attached to the name of various "φυσικοί," especially to that of Empedocles. Now, with regard to these apophthegms, we may always question whether these parts of ancient geogenics were based on even one scanty observation of the general aspect of fossiliferous strata or metamorphic and crystalline rocks, or were called into existence by vague simulation, such as probably gave birth to that article of Empedoclean faith which denominated the moon an "ἀπόσπασμα" of the sun. But those Origenean lines of Xenophaneology shed a better light upon the topic. It is here that we cannot deny a geological induction, here that we cannot doubt that our philosopher did observe phenomena of physical geography in connexion with fossil remains before he exclaimed that the present physiognomy of things is destitute of stability, that the physical world, being kept in perpetual decline, approaches towards an irrevocable decay, and that the organic "γένεσις" on our earth's surface will be in the same way reborn after terrible catastrophes as it has been reborn before, not one time only, but many times infinitely. Alexander von Humboldt recognized the importance of the words of the church-father; and every naturalist will do so when he takes into consideration, besides this record itself, also those accounts according to which our Colophonian exile was deeply immersed in the study of the volcano in the isle of Lipara during his sixty-seven years' erring (as he styled it himself) "in the search of truth."

Now these two passages bear, so to say, a somewhat direct evidence that there were pre-Alexandrine Greek philosophers who already cast a glance, if even a most short-sighted one, upon the chthonological section of the tellurian crust.

I am strongly convinced that not only Xenophanes and Empedocles made in those antique days similar observations or even investigations, but also others—a great part, perhaps, of those so-called "*φυσικοὶ*" whose mental structure rather inclined them to the inductive method, to the "*ἐπαγωγή*," as it is called by the Stagirite, and not to the presumptuous and haughty opposite one. That we now are wholly unacquainted with their acquirements is a mere consequence of the disintegration of the preserved literary remains. Truly this ought not to be regarded as a statement without any foundation and yet panting for a generous assent on the part of disgusted thinkers; for, with the deficiency of material conditions, the general sense of their fragmentary cosmogonistics contains, in most cases at least, the formal arguments of a geological framework. I mean the "*διακόσμησις κατά τινας περιόδους.*"

Almost all Greeks who wrote under the titles "Περὶ φύσεως," "Περὶ κόσμου," "Περὶ τοῦ παντός," "Περὶ τοῦ ὅλου," "Περὶ τοῦ ὄντος," yielded either willingly or unperceivedly to those impressions with which a susceptible mind rapidly becomes impregnated, on the verdant surface of this awry planet. This becomes evident from the very circumstance that almost all such writers assume the doctrine of the periodical destruction of the world. And in fact the so-called Mundane, or Great, Years, are very often to be identified with the periods of "*ἀποκατάστασις*," denoting a geogonical meaning as well as an astronomical one. Such great cosmical intervals of time are, particularly, the "*φιλία*" and "*νεῖκος*" of Empedocles, the "*Perfect Year*" of Plato, and the "*είμαρμένοι χρόνοι*" of the later Stoics. As I have inferred in my writing on the "Palæontological Theory of Empedocles," the manuistics of sacred Hindoo literature afford in this respect a very good analogy, with their manvataras and sadriyugam; so also the saroi of pseudo-Chaldaic tradition.

I have no leisure at present to enter the field of comparative mythology, and must restrict myself to the suggestion that all the cosmical periods of the above-categorized authors, as well as of others, as poets (for example, Ion of

Chios) who soared up in their dithyrambs to the nature of things, were intended to denote something entirely different from the calendroleschic cycles of Meton and his fellows. Nobody will easily concede, if a little conversant with the subject through reading in ancient writers, that any Greek philosopher ever taught a destruction of the world at the end of cycles of 2484 years, composing the great year of Aristarchus the Samian, nor even in those of 5552, as giving that of Aretes the Dyrrhachian, lest we should trespass on the obvious nature of cycles composed of nineteen years: but the periods of Linus and Heraclitus (asserted by Censorinus and Stobæus to have consisted of 10,800), those of Orpheus (asserted by the same authority to have amounted to 120,000 years), might very probably comprise the revival of the organic kingdoms from some deluge, or even the evolution of nature from a chaotic state in their view, in addition to the precise return of all the heavenly bodies to one and the same original starting-point. We readily add that the pleasing writer of the book 'De die natali' was better informed with regard also to the 10,884 years of Dion of Neapolis, the 2,600,000 of Cassander the Salaminian, than to the above years of Aristarchus, when he paralleled the aims of all these periods with those of the "greatest year" mentioned by the Aristotelian 'Meteorologics,' whose winter was professedly arrived at in the "κατακλυσμός," and summer in the "ἐκπύρωσις." To this last category seems also to have belonged data contributed by Alexandrine and Byzantine authors, such as that of a Ciceronian quotation (12,954), of Macrobius (15,000), and of Nicetas Choniata (not less than 17,503,200 solar years).

Respecting Empedocles we know approximately what the great years, so to say, of his "διακόσμησις κατά τινας περιόδους" contained. The "φιλία" meant a somewhat chaotic state, like that described by Euripides in one of his lost tragedies, and more markedly by Ovid in the first book of his 'Metamorphoses'—the things reduced to their four elements aggregated in a huge sphere and vivified, so to say, by the supremacy of fire. The "νεῖκος," again, designated that era during which the things began and continued to emancipate themselves from their conglomerate aspect and assume a physiognomy rather similar to the present one. Both "φιλία" and "νεῖκος" served originally to denote the two principles by which the Agrigentinian naturalist believed the lot of this universe was balanced, the principles of "friendship," "love," or, if you will, "attraction," and of "hostility," "hatred," or "repulsion;" and it is only in a tropical sense that they were nominally confined to the periods they alternately governed. This government, on either side, did not prove, we are told, an exclusive one: there also acted during the period of "νεῖκος" the opposite principle; so in the beginning of the γένεσις (for we may substitute in this signification the period of "νεῖκος" equivalently with the more popular term "γένεσις") its energy was deemed to be scarcely felt, but later it increased greatly, finally outstripped the reaction of the other, thus producing the the period of "φιλία." The end of the world was, in the scheme of Empedocles, caused, as well as its commencement, by the power of fire, "ἐπιβρίσαντος τοῦ πυρός." Besides those hypothetical peculiarities, or rather failed reconstructions, advanced by Empedocles with regard to the past of faunas and floras, which I shall introduce to the reader in the subsequent chapter, this topic remains the only one amongst the whole treasury of his fragments which may in a sober manner amuse the modern geologist. All other features of his cosmogony, as well as of almost all old "φυσικοί," yet extant, involve the loosest extravagances of stœchioleschical speculation, traceable, as Gladisch suppose, to Egyptian lore. The modern naturalist, however, will not be so puzzled by the pretended fact that some of our ancient Greek philosophers had taught a genesis by way of "ἀλλοίωσις" (so the older Ionians from Thales to Heraclitus, all of them being "ἓν εἶναι λέγοντες"), others, again, by way of "σύγκρισις καὶ διάκρισις" (so Anaxagoras and Empedocles, being "ἓν καὶ πολλὰ εἶναι λέγοντες," or Leucippus and Democritus, being "πολλὰ εἶναι λέγοντες"); the naturalist will not feel so puzzled as the philologist at seeing how much time and intellectual skill has been sacrificed since the days of Aristotle in order to ascertain the true metaphysical point of view of each philosopher's cosmogony. He will regret that, in order to enrich the labyrinthine complexity of such subtleties with new quotations, Christian authors omitted to hand down the outlines of the most important inductions respecting tellurian subjects. He must of necessity overlook the disputes of Tennemann, Tiedemann, Brucker, Brandis, Zeller, Schaubach, Karsten, and Schwegler, and deal exclusively with passages of a peculiar nature: thus all excogitable changes asserted to have befallen the elements ("στοιχεῖα," or principles, "ἀρχαί") will lie beyond his attention; the same would hold true also as regards the question of a "δραστήριος ἀρχή." Consequently I must confine the summary of my review of the pre-Alexandrian "φυσικοὶ" to the following remarks.

We have seen that Empedocles is asserted to have believed in the periodical destruction of the world by fire: similar tenets, absolutely or in connexion with alternating "κατακλυσμοί," we find attributed to Orpheus, to the Pythagoreans, to Xenophanes, to Parmenides, to all the Ionians (not even Thales himself excepted), to Leucippus, Democritus, Plato, Aristotle, and later to the adherents of the Stoic philosophy. The dogma was that this destruction by fire, "ἐκπύρωσις" or "ἐμπρησμός," affected the whole universe, not our earth alone, and it was suggested to be effected by that infinite mass of fire with which the puerile fancy or ophthalmic disease, so to say, of many "φυσικοὶ" filled up the "κενὸν" beyond the starry sphere. Such appeared to be the common decision of philological critics. Notwithstanding, I have already alluded in my Greek essay 'Περὶ φύσεως' to the probability that those who professed a geological central fire in the interior of our globe, or something similar, as Empedocles and the most enlightened of the Pythagoreans, did not derive such a fire from the heavens as did the lost 'Dramaturgics' cited by Eusebius; and if this be granted, we may admit also that their catastrophes, perhaps restricted to the combustion of organic nature, must have been of a less chimerical character.

The "κατακλυσμοὶ" seem always to have had heavenly waters assigned as their producing cause. The Sanscrit books of tradition furnish us with a very striking illustration in this respect. Greek literature might afford a few scanty data, as, for example, that recorded by the 'Ἐκλογαὶ φυσικαί' of Stobæus, and pretending that, according to Philolaus a Stoic (Boeckh identifies him with the Pythagorean), the waters of the moon would encroach periodically upon the earth, alternating with conflagrations. Another account is given by Plato, which we shall see in the sequel.

Now, we are unable to lift the veil enveloping the cognate theories of Pherecydes, Pythagoras, Anaximander, Anaximenes, Anaxagoras, Archelaus, Xenophanes, Parmenides, Melissus, Leucippus, and Democritus. As regards Thales we can go as far as to contradict those on the one hand who explain so curiously in harmony with the Aristotelian report his famous sentence upon the origin of the world from water, and those who directly assert that all his apophthegms imply a Neptunistic origin of rocks. I have read something like the latter assertion in the last chapter of a renowned recent textbook of geology, devoted to the history of the science: I must nevertheless declare such an assertion unscientific. We may guess that, being Phœnician by extraction and educated in Egyptian lore, Thales had already some notion about the nature of sedimentary strata, and we may also refer to those somewhat spurious statements, according to which the father of Ionian philosophy believed also in an alternating destruction of the world by fire; but that is all we can do.

Heraclitus is also generally introduced by the moderns as an ancient volcanist. For my part, I have no evidence that the end of his 10,800 years period was to be terminated by an eruption of volcanos.

The theory of Aristotle is not yet to be ascertained. He professed "κύκλον εἶναι τὰ ἀνθρώπινα," he preached the myths to be allegorical explanations of natural phenomena and the religious cosmogonies to be "ὅσα λείψανα," the ruins of civilizations which had passed away. Yet his catastrophes cannot have that aspect which Censorinus attributes to them.

We only know about the periods of the ancient naturalists this, that the latter deemed them to be brought forth by terrestrial catastrophes. This alone justifies us in paralleling those unfortunate "φυσικοί" with our geologists: for it is possible that some of them had conceived an ardent desire for a curtain-fall in the theatre of organic life, or rather of human life, from the careful examination of moral phenomena; possible also that some had longed for those terrible flames which might scorch the whole earth, with all the matricides, traitors, and sceptred liars, or for those cool waves which might, whilst sweeping over luxurious towns and melancholy forests, bear away also the pains of disappointed hopes, the troubles of their profitless youth. Yet the circumstance, alone, that those philosophers who lived in the vicinity of volcanos always adhered to the doctrine of a final conflagration, and those who lived near the sea always to that of a final cataclysm, removes any analogy to the religious appreciation of the "signs of the times" as given in Sacred history.

Anaxagoras is the sole ancient philosopher who rejected the theory of periodical destruction and renewal,—as we are told by Themistius, in his paraphrase to the 'Φυσικῆς ἀκροάσεως' (i. p. 18), that "οὗτοι ['Εμπεδοκλῆς καὶ Αναξαγόρας] οὐ κέχρηνται πρὸς τὴν γένεσιν ἀλλοιώσει, ἀλλ' ἐκ τοῦ μίγματος ἐκκρίνουσιν ὡς ἐνυπάρχοντα ἤδη τὰ ἡμῖν γίνεσθαι δοκοῦντα· ἀλλ' ὁ μὲν παύει τὴν ἔκκρισιν ταύτην, καὶ πάλιν ἄρχεται κατὰ περιόδους, 'Αναξαγόρας δὲ, ἅπαξ ἀρχὴν λαβοῦσαν οὐκ ἔτι τελευτᾷ."

Stobæus and others rank him with the "φάμενοι περιοδευτικοὺς χρόνους," but without any ground. Under some wide considerations he might be compared to the followers of the unitarian scheme of Sir Charles Lyell. But when speaking thus, we ought not to forget that this holds true only if he be contrasted with men like Empedocles. The ordinary course of nature as assumed by Lyell and as assumed by a contemporary of Pericles differs essentially. Anaxagoras taught that the formation of stars from rocky portions of the earth thrown off by his "whirl" continued to go on even in his own days. The ancients thought that space which we now people with infinite suns and nebulæ to be ornamented with material objects only some thousands of miles distant from the earth, and held the latter for the centre and most important thing in the whole universe. Thence we find grand changes in the condition of their celestial bodies involved into the usual biological process of our domicile. In addition to this, our Clazomenean adhered to the assumption that the first appearance of animals was accompanied by a spontaneous southward shifting of the cosmical axis; and he adhered to this assumption as affectionately as Diogenes of Apollonia or the Agrigentine sage. The difference, then, between the scheme of Anaxagoras and those of Empedocles and others seems to be confined to the question of a *suspension* or *non-suspension* of the peculiar stœchic movements believed in by them, and above all of their "*κίνησις*."

In my Notes I shall dwell a little more at length on the relation of the poets (as Orpheus, Linus, Pamphus, Eumolpus, Homer, Hesiod, &c.) to the old "*φυσιολογία*"; and I shall there review the cosmogonical views spread over the works of the didactics,—so the Orphic hymns, with their mundane egg, a trait traceable to Epimenides and to Egyptian traditions, the Hesiodic doctrine of an ecpyrosis, &c. It was rather Pherecydes the Syrian, the author of the '*'Επτάμυχος*,' whose "*ὑπόπτερος δρῦς*" and the "*ἐπ' αὐτῇ πεποικιλμένον φάρος*" might be immediately connected with the oak, &c., in the Egyptian 'Book of Metempsychoses,' the "Sai-en-Sen-sen," and whose mystical compliments to the antiquity of earth might shed some light upon the state of Nilotic geogonics in the sixth century B.C. But at present I confine myself to Plato.

The "Atlantis question," as introduced in his 'Critias,' has already continued for many centuries to occupy men of science. We know that Solon wrote a poem '*'Ατλαντις*'; we know that many scholars have since written under the same title: yet we shall never be able to point out the real geological merit of this suggestion of Plato's with rigorous precision. On my part, I feel more ready to take for granted that it owes its origin by no means to our philosopher's own observation, but had a foreign derivation. The late Baron von Humboldt has well referred to mythical analogies of this kind under different latitudes: The conjecture of those who prefer the Gulfoid I deem more credible than any other. For it cannot be doubted that Plato had acquired some respectable notions about physical geographics; it is no matter of doubt that his bombast comparing the tribes around the Mediterranean to the frogs around some marshy little lake was prompted by an appreciation of the result of ancient exploring expeditions.

Plato's relation to foreign, or, as Meiners would have said, barbarian lore, is elucidated better than by anything else by the words the writer of the dialogue 'Timæus' lends to the lips of the Egyptian priest: "O ye Greeks, ye are always children, there is no old man amongst you. Young are ye all in your minds, for ye have neither old traditions, nor a science grown grey by antiquity;" and again, "there happened already many destructions of mankind in many places, and will yet happen,—the greatest through fire and water, less ones through various other causes." The philosopher discovers in the myth of Phaëthon an allegoric eternalization of the doctrine of the periodical catastrophes of the world by fire, and mentions a "*ῥεῦμα οὐρανῶν*," a heavenly deluge which would sweep over our globe at the end of a certain accustomed number of years "like an epidemic." His great year, or, as he styles it, his "*perfect year*" ('Timæus,' pp. 39, 40; and 'Republic,' p. 381, 13 f), reminds us of the hypothesis of Adhemar, though the sum of the chiliads and centuries of the Greek does not coincide precisely with the 10,500 years of the latter, and though no "glacial theory" can ever be attributed to the former.

Aristotle, as I have stated above, and as I shall repeat in the sequel, neglected geological investigation. Beyond a cursory hint on the cataclysm in his 'Physics,' his admirable chapter in the first book of his 'Meteorologics' faintly regards physical geography alone: he goes no further, he does not take into consideration what all those slow changes could produce in the lapse of enormous intervals; or if so, he holds in contempt every possible change of the sublunar world at large, and therefore does not look into the tellurian crust to discover the vestiges of such alterations: nor may we entertain any hope that his lost writings, if brought to light, would show another demeanour.

It was unfortunate for the history of the efforts made by the Indo-German races to arrive at some recognition of the true scheme of the universe in space and time, that this man had an aversion to geology, or was too overwhelmed with researches in other branches of knowledge—the man who exhibited the best-suited mind amongst the Greeks for natural investigation, and who, freed from every prepossession, even admitted the myths to be veiled explanations of cosmical phenomena.

CHAPTER V.

Having thus made acquaintance with the changes observed by the Greeks in the inorganic worlds, or at least with their cosmical periods, let us now look at the way in which they attempted to reconstruct the development of animal life.

There are but a few authors, from the periods the merits of which I undertook to sketch at present, who positively assert their own observation of fossils, as Xenophanes, Xanthus the Lydian, Herodotus, Eudoxus the Cnidian, and Aristotle; nevertheless we shall, in the sequel, recount the fragments of theories left by other philosophers, which almost indisputably bespeak a palæontological induction; so that, although they contain no expressions referable to a "petrifaction" or "fossil," we must take them far more as intentionally geological investigators than the historians, logographers, or mathematicians above alluded to.

Xenophanes the Colophonian is the sole Greek writer of whom we may speak as indisputably an inductive geogonist; he is the sole naturalist to whom Greek tradition attributes even the definition of fossil types. Origenes the "Diamond" informs us that our famous "*φυσικός*" was aware of the several "*κόγχαι*" (shells) found midland, or on the top of the highest mountains, of the "*τύποι ἰχθύος καὶ φωκῶν*" found in the pits of Syracuse, of the "*τύπος ἀφύης*" found in the depth of the rock on the isle of Paros, of the "*πλάκας συμπάντων θαλασσίων*," finally, found in Melitos. All this, he said, had originated of old, when the universality of things was subject to muddiness ("*ἐπηλώθησαν*"), and then the "*τύποι*" had become dry in the mud ("*ξηρανθῆναι*"). Now, an acute philologist, Prof. Karsten, translated the "*ἐν μεσῇ γῇ*," "in terræ visceribus;" "*τύπον*," as to the fishes and seals ("*φωκῶν*"), "vestigia," as to the "*ἀφύης*," "impressa forma;" the "*πλάκας*," "crustas." A different interpretation was adopted by Lassaulx—who reads, following a Gronovian conjecture, "*δάφνης*," favoured by the majority of codices: for instance, that of Munich, Gr. 68, translates "*ἐν μεσῇ γῇ*," "mitten im Binnenlande;" "*τύπον*," "Abdrücke von Fischen und Phoken;" and "*πλάκας συμπάντων τῶν θαλασσίων*," "Abbildungen von allen Meereserzeugnissen." For my part, I deem superfluous every anguish of mind, as well as feel inclined rather to applaud those who would explain those "*τύπους*," not as the "impressions," but as the actual "fossils" of fishes, seals, and anchovies (or, better, in my opinion, laurels). The "*πλάκας*" at least ought to mean certainly more than "impressions;" nay, even as to the vestiges of all the above animal or vegetable types, we may prefer "their skeletons fossilized;" for the words "ἐν τῷ πηλῷ ξηρανθῆναι" are by no means inconsistent with this interpretation. However it be, it remains impossible to guess what individual species, and in what stage of the stratified terrestrial crust, could excite the curiosity and satisfy the mind of the Colophonian; but it will prove sufficient for the history of geology under such circumstances to show that the views ascribed in the 'Φιλοσοφούμενα' to Xenophanes belonged really to him, and not to Xenocrates, or to another thinker of a similar name; for the celebrated records, both Greek and Roman, affirming that the great philosopher indulged in the doctrine of an "inhabited moon," have occasioned a serious and interminable controversy. Here, again, the honour of philologists requires vindication.

Xanthus the Lydian has mentioned, in the lost books of his 'Λυδιακά,' the multitude of fossil marine shells, the "λίθον κογχυλιώδη," the "κτενώδεα," and "χηραμύδων τυπώματα" to be found in Armenia, Phrygia, and Lydia, as we saw in our preceding chapter. Prof. Lassaulx does not appreciate the difference probably expressed in these terms, "λίθος κογχυλιώδης" and "χηραμύδων τυπώματα." He speaks of "muschel- und kammähnlichen Versteinerungen," where the "muschelähnlichen" ought to explain the "λίθος κογχυλιώδης" as well as the "kammähnlichen" the "τὰ κτενώδεα." This is a mistake. The Lydian logographer observed exclusively fossil shells; in those three denominations, at least, he certainly intended to communicate to us his observation of such remains; and then we cannot contrast the "λίθος κογχυλιώδης" as shells with either the "κτενώδεα" or the "χηραμύδων τυπώματα" as organic remains, which might have, according to Xanthus, represented anything whatever save shells again. For I submit that the "τυπώματα" should signify on this occasion more decidedly "impressions" than in the phraseology of the Origenean Xenophanes.

Herodotus the Halicarnassian also admired fossil shells, and more particularly those extant in Egypt. He names them briefly "κογχύλια φαινόμενα ἐν τοῖσι οὔρεσι." We have seen, in the fourth chapter, what conclusion he draws from this circumstance. Here we may add that the "Father of Historiography" seems not to have aimed at a special definition of those remains, and to have confounded the so-called "Nummulith-limestone" with real lentils.

Eudoxus of Cnidus, the famous mathematician and astronomer, alleged the case of the "ὀρυκτοὶ ἰχθύες" ("fossil fish"). Such piscine petrifactions had been dug out (so the noble contemporary of Plato, in the 'Geographics' of Strabo), in Paphlagonia, "ἐν ξηροῖς τόποις," as well as, in the vicinity of the Ascanian lake (ὑπὸ Κίῳ), in a humid soil (ἐν ὑγροῖς).

Aristotle himself mentions these fishes in his treatise 'Of Respiration.' "A great number of fishes," he writes, "live in the earth motionless, and are found when dug out." Such words are of unquestionable importance if uttered by an author whose investigations, speculations, and learning have ever been placed by those who hold themselves for sober scholars above everything else that Greek science produced concerning the study of nature, and more especially that of the animal kingdom. We are then, of course, surprised at such coming from the Stagirite, after having witnessed the discretion, in this respect, of Xenophanes. Yet his renowned pupil, Theophrastus of Eresus, corroborates us in our indignation. In his essay '*Περὶ τῶν ἐν τῷ ξηρῷ διαμενόντων ἰχθύων*,' he displays his theory of the origin of those fishes which modern geologists would declare, at the very first sight, to be fossil, that these fishes ("*ἰχθύες ὀρυκτοὶ*") found near Heraclea, in the Pontus, and, according to the pupil of Aristotle, in Paphlagonia, had either been procreated from fish-spawn left behind in the earth, or had gone astray from the rivers or from the sea, for the sake of food, into the vaults terrestrial, and so had become earthy themselves. Hence we may surely infer how little the Eresian could learn in regard to these matters from Aristotle. In the writing '*Περὶ λίθων*,' the same favourite pupil touches upon fossil ivory, the "*ἐλέφας ὁ ὀρυκτὸς, ποικίλος μέλανι καὶ λευκῷ*," and upon fossil bones: when alluding to the mode in which they might have originated, he supposes, however, that they were produced by the certain "plastic virtue" latent in our earth; nay, he knew even the *impressions of palms* in the stone of the Hispanic Munda, even those black impressions in the marble of Tænarum; his mind remained, however, blind to the characters of our planet's autobiography, and could not participate in the delight of some older "*φυσικοί*."

There were, on the other hand, philosophers of older date, the fragments of whose books bespeak a veritable palæontological investigation. Neither Anaximander the Milesian, nor Empedocles the Agrigentinian, could in our own days be demonstrated to have used expressions like "*ἀπολελιθωμένα*" and "*ὀρυκτοὶ ἰχθύες*"; yet the apophthegm in which the former taught that mankind had derived their origin from fishes would prove him an observer, no less indisputably than the monstrous reconstructions of the latter, the "*κύρσαι ἀναύχενες*," the "*ἀμφίστερνα*," "*ἀμφιπρόσωπα*," the "*βουγενῆ ἀνδρόπρωρα*" and "*εἰλίποδα κριόχηλα*." We find in the 'Placita Philosophorum' of the pseudo-Plutarchus the celebrated words, "*Ἀναξίμανδρος, ἐν ὑγρῷ γεννηθῆναι τὰ τρῶτα ζῶα, φλοιοῖς περιεχόμενα ἀκανθώδεσι, προβαινούσης δὲ τῆς ἡλικίας ἀποβαίνειν ἐπὶ τὸ ξηρότερον, καὶ περιῤῥηγνυμένου τοῦ φλοιοῦ, ἐπ' ὀλίγον χρόνον μεταβιῶναι*." The intelligence about these "first animals" "covered with aculeated integuments" "arising ἐν ὑγρῷ" (meaning probably the "Urschlamm" of many unlucky philosophers, both ancient and modern) would enlarge the conceptions we previously entertained of the Anaximandrian primeval fauna, if we only had that report at our disposal according to which men had been originated *in the fishes* at the beginning. Plutarchus, in the eighth book of his 'Symposiacs,' has preserved for us this strange hypothesis. Now, the clever historian of Ionian Philosophy, Dr. H. Richter, supposes that this piscine pregnancy, alleged in the Anaximandrian "διαδοχή," was thought to have happened posteriorly to the epoch of the above-mentioned "πρῶτα ζῶα" "covered with aculeated integuments." Cuvier, meanwhile, speaks in the following strain upon the matter to the reader of his 'Histoire des Sciences Naturelles':—"Quoi qu'il en soit, Anaximandre ayant admis l'eau comme le second principe de la nature, prétendait que les hommes avaient primitivement été poissons, puis reptiles, puis mammifères, et enfin ce qu'ils sont maintenant. Nous retrouverons ce système dans des temps très rapprochés des nôtres, et même dans le dix-neuvième siècle." Modern geologists who have cultivated philology will, I expect, both tax the German metaphysicians with arbitrary procedure, and the French naturalist with extreme boldness. Richter would scarcely be able to state the grounds upon which he thought proper to arrange in that manner in time those pretended primitiæ of animal life, to say why he would have us believe that the creatures "covered with aculeated integuments" were thought to have preceded the man-parent and man-breeding fishes? With hints on the circumstance that the principle of progressive development seems to have pervaded also the hypothesis of the Milesian, that, in the scheme examined, mankind were most probably to appear ultimately on earth also, we shall never content ourselves. More seriously ought we to animadvert upon the words of Cuvier. The great palæontologist could hardly have read, in any classical author, of reptiles which represented the zoological aspect of primitive human beings after the latter had put aside their piscine type. He was right in guessing that those expressions in Plutarchus can be scientifically interpreted only if we take for granted that Anaximander declared fishes to be the oldest ancestors of the present fauna (and more especially of the human race) because he found their "fossil relics" in the "lowest fossiliferous strata;" but he did wrong in attempting to redintegrate the deficiency of the conceded chain of progressive development, and especially in attributing to the pupil of Thales *nuances* for the most part peculiar to the age of Lamarck. However, I agree with him in recognizing here attempts advancing rapidly towards palæontological induction. Was Anaximander an original investigator? or did he borrow these tenets from Nilotic lore? This remains yet a question, and one which at present we dare not answer. The myth of Oannes, as extant in pseudo-Chaldaic or pseudo-Phœnician forgeries, would possibly furnish an analogy to this apophthegm—nay, perhaps even the piscine hero of that episode of the Mahabharata which sings of the Bramanistic deluge: when meditating upon such analogies we should, however, feel rather inclined to believe that their authors intended to express by allegories of this description the probable expedient of organic nature's deliverance from the catastrophes destroying periodically the established order of phenomena; and we ought, in this case, to make the probable origin of the above hypothesis dependent upon the light in which we view the external conditions of those cosmical periods just alluded to. If we prefer to suppose that the cycle of a certain number of periods (each of the latter producing a new development of the animal and vegetable kingdom) was, in the opinion of our philosophers, to commence anew with the appearance of man, and to go on in this way infinitely, or at least to be repeated several times, then the piscine "ἀρχαί" of the Anaximandrian "κοσμοποιΐα" may have had some common traits with the quoted Oriental and Nilotic cosmogonistics. But in this case we must suspend the catastrophes *within* such a whole cycle of periods; the cycle itself ought, according to this assumption, to be terminated by a cataclysm or ecpyrosis, and not the single periods constituting an entire cycle. How the progressive development of organic types was proclaimed in conformity with this partial unitarianism to have been effected, is a problem I would not take upon myself to solve. Nevertheless, did the countries visited by Anaximander afford such an abundance of Devonian fossil fish, as the volcanic character of Sicily has accounted for the Empedoclean subterranean fire, I should be ready to infer the statement of the pseudo-Plutarchus to have been the result of his autopsy. He might have seen piscine fossils in the depth of the primary strata, and the fossilized remains of even more highly organized beings buried in the vaults of the ascending series of secondary and tertiary formations, and thence he might have drawn the rough conclusion, that organic nature, more especially the animal kingdom, was doomed to run through a progressive development which commenced with piscine features and ended with what we ordinarily style the "crown of creation," man,—a doctrine both very homætiologistical and very homoteleologistical with the various attempts of modern date to decipher the history of life. This, I repeat, might have possibly been the groundwork and the contour of his palæontological system, the very fruit of his probable travels, observations, and investigations; and yet we have no reason to deny, if we even admit his autoptic merits, that at the same time he could have drawn upon Nilotic lore, and participated in that teaching which probably furnished the data as to the development displayed in the history of the six days of the first chapter of the Pentateuch. Herodotus frankly confessed that he had been instructed by the priesthood of Egypt in matters that regarded the physical geography of that country; he, however, did not fail to prove himself an independent observer: he added everywhere, that every traveller must infer the alluvial origin of the Delta from mere sight; nay, he who imbibed, we admit, the love of cosmical inquiry at first from conversation with the Hephæstian sages of Memphis, continued to reflect, when returning to his native home, upon similar phenomena, to compare the sediment-carrying energy of the Achelous and other rivers, to take into consideration even what might happen if the Nile would direct its deposits into the Arabian Bay. Why may we not then take it for granted that the Milesian himself pursued aims which coincide, in the comprehension of men still living, with those of palæontology? Prof. Röth has sufficiently demonstrated that our philosopher borrowed his doctrine's chief features from Egypt; Dr. Richter has well remarked that his apophthegm relating to the "unrighteousness of the world's birth" which we have touched upon in the fourth chapter, has much in common with Hindoo nirvânistics; and I will not contradict them. I concede that not only the metaphysical boldness of his philosophy relies upon foreign hospitality, but also the motives of his cosmical speculations: but in the present case, I firmly believe that his palæontological theory, as far even as we can judge it from those scanty fragments alone, possessed something peculiar to his individual mental structure, that neither are those animals covered with aculeated integuments to be traced back to the valley of the pyramids, nor yet the lost plan of the whole, which we are now unable to study by supplying the wanting intermediate links from the piscine *initia* to the appearance of man. Plutarchus quotes, in the eighth book of his 'Symposiacs,' amongst other matter, also the authority of Anaximander for the question, "Why are some philosophical sects forbidden to eat fish?" and then inserts those words which we have already noticed. That the real cause of this abstinence may have been only a motive of piety towards those animal types in which the germ of human existence had first witnessed the benevolent solar ray, every modern geologist will feel inclined to conjecture when reading what I have just accumulated, and, perhaps, modern scholars of any description rather than philologists: but I must declare, after all, that this famous abstinence from fish easily impels the modern student to a conjecture as regards also the probably achieved, yet now lost, observations of the Pythagorean Confederation—a conjecture which, notwithstanding, will fall short of being justified by certain passages of ancient authors wherein this abstinence is treated of ætiologically, such as Eusebius, Origenes, or, on the other hand, Herodotus, Plato, Diodorus. The adhesion of Empedocles to similar caprices by no means facilitates an explanation; it is only from the general aspect of his palæontological efforts, that, in dealing with this ungrateful "διαδοχή" of ancient naturalists in general, we may be encouraged to hope.

Empedocles of Acragas certainly erected his own theory of fossils. Although the literary remains yet extant have preserved not a single case in which he has spoken of similar specimens in such language as we have met with in connexion with Xenophanes, Xanthus, or Herodotus, or as we could meet with in connexion with later philosophers—Theophrastus, Strato, or the Amasean geographer—although such an instance is indisputably wanting in the literature of commentators and philologists, Empedocles stands isolated, in the whole series of ancient "φυσιολόγοι," as one whose strictly palæontological achievements we cannot doubt. Anteriorly to these my studies, often already had the striking resemblance, as to the whole, of his "βουγενῆ ἀνδρόπρωρα" and his "εἰλίποδα κριόχηλα" to the reconstructions of a Cuvier, of a Wagner, of an Owen, been hinted at; men of science seem, however, to have failed, till now, to give to the history of geology the benefit of the certainty of the resemblance thus mysteriously intimated. I feel, therefore, sincerely happy to have discovered a passage of Johannes Philoponus, from which it will become evident that the types of all those monstra, of all the "ἀμφιπρόσωπα" and "ἀμφίστερνα," &c., which the Acragantinian naturalist sings of in the second book of his didactic poem 'Περὶ φύσιος,' were originally observed by him in veritable fossil relics imbedded in various rocky strata. But let us review, before returning to this new argument on behalf of Greek merits, the diversity of the related Empedoclean palæontological types. The great work of our philosopher, entitled "Περὶ φύσιος," has not been handed down to us in such a state as could enable the reader of its fragments collected to take a complete survey of the whole range of those gorgeous beings with which he peopled the gloomy scenes of his various cosmical periods. Philologists, and amongst them particularly Sturtz, deserve our gratitude for having restored at least the 360 hexametric lines, and having grouped them together into a scheme which, though arbitrary for the most part, possesses some psychological cohesion. According, then, to this arrangement of the philologist, it is in the second book of the above poem that Empedocles presents his reconstructions, as follows:—"οὐλοφυεῖς τύποι χθονὸς" ("formæ totam vim generandi confusam necdum explicatam in sese continentes," as explained by Sturtz); "they were brought up [sent up, ἀνέπεμπε] by fire," continues the Acragantinian "θέλον πρὸς ὅμοιον ἱκέσθαι"; "neither the single traits of membral structure were yet distinguishable, nor had they yet the gift of voice." The second stage of types is described in the lines subsequent to those in which the philosopher deals with the elementary components of the blood, flesh, and bones—subsequent, I say, to the verses,

> " ἡ δὲ χθὼν τούτοισιν ἴση συνέκυρσε μάλιστα,
> Ἡφαίστου τ' ὄμβρῳ τε καὶ αἰθέρι παμφανόωντι
> Κύπριδος ὁρμισθεῖσα τελείοις ἐν λιμένεσσιν,
> εἴτ' ὀλίγον, μεῖζόν γ', εἴτε πλέον ἐστὶν ἔλασσον,
> ἐκ τῶν αἷμά τε γέντο καὶ ἄλλα τε εἴδεα σαρκός,"

and again,

> " ἡ δὲ χθὼν ἐπίηρος ἐν εὐστέρνοις χοάνοισι
> τῶν δύο τῶν ὀκτὼ μορίων λάχε Νηστίδος αἴγλης,
> τέσσαρα δ' Ἡφαίστοιο· τὰ δ' ὀστέα λευκὰ γένοντο,"

verses preserved by Simplicius in his commentary on the first book of Aristotle's 'Physics,' and by the latter in his treatise 'On the Soul,'—verses with respect to which, in spite of the inaniloquence of later authorities, we are now unable to decide whether their scope was merely embryological or connected simultaneously with a speculation upon the origins of animal life on the surface of our globe. The lines themselves containing those types of the second stage, as I remarked above, commenced not improbably with

> " ἐξ ἄρθροιν δὲ δυοῖν καρπὸς συμπήγνυται αἰεί,"

which has been referred by later physicists to physiologistics; but the following indicate, at all events, reconstructions altogether different from those of the first stage, and lay claim, decidedly, to a higher degree in the scale of that fabulous, or, rather, monstrous organization:

> " γυμνωθέντα τὰ γυῖα μεμόρφωται, δίχα τ' ὤμων,
> ὅσσε δὲ οἴω ἐπλάσθησαν νόσφι μετώπων."

What then follows according to Sturtz's arrangement,

> " πολλὰ μὲν ἀμφιπρόσωπα καὶ ἀμφίστερνα φύεσθαι,
> βουγενῆ ἀνδρόπρωρα, τὰ δ' ἔμπαλιν ἐξανατέλλειν
> ἀνδροφυῆ βούκρανα· μεμιγμένα τῇ μὲν ὑπ' ἀνδρῶν,
> τῇ δὲ γυναικοφυῆ σκιεροῖς ἠσκημένα γυίοις,"

was preserved in the 'Animal history' of Ælian (xvi. 29). Such are the forms of this stage: "βουγενῆ ἀνδρόπρωρα," "fœtus bovini, hominis facie;" "ἀμφιπρόσωπα," "bifrontia;" "ἀμφίστερνα," "bipectora;" "and what grew up in the sequel" (perhaps we might be justified in so translating the "δ' ἔμπαλιν ἐξανατέλλειν"), "ἀνδροφυῆ βούκρανα," "fœtus humani, bubulo capite." The philologists have joined to the train of all these hexameters, not immediately, but intercalating

"Κύπριδος ἐν παλάμῃς πλάσιος τοιῆσδε τυχόντα,"

another, which I declare, however, altogether misplaced. Aristotle quotes in his treatise 'Of the Soul' the line

"ᾗ πολλῶν μὲν κόρσαι ἀναύχενες ἐβλάστησαν."

If we now take for granted that the reading "πολλῶν" must be substituted by "πολλαὶ" (as various MSS. admit this conjecture), and translate the exclamation in a sense which would suggest that Empedocles sung of "heads without necks" (and, indeed, Johannes Philoponus as well as other authorities confirm such an assumption), we shall not be wrong if we infer that the animal types expressed by this solitary line seem to have even represented a more primeval stage of development than the two above hinted at. And thence it would follow that the philologist's arrangement of the relics of the Empedoclean 'Περὶ φύσιος' falls undoubtedly short, as I have said, of being the authentical one, that modern scholars might, when intending to analyse the palæontological doctrine of the Acragantinian, by no means rely exclusively upon the testimony of the saved own words of our philosopher. Happily, besides the commentators on Aristotle (Simplicius, Themistius, Johannes Philoponus, &c.), we can cite also the author of the pseudo-Plutarchian ''Αρέσκοντα,' who wrote, in the fifteenth chapter of his fifth book, under the title "Περὶ ζώων γενέσεως, πῶς ἐγένοντο ζῶα, καὶ εἰ φθαρτά," after touching upon the views of Epicurus, Anaxagoras, Euripides, and Anaximander, as follows:—"'Εμπεδοκλῆς, τὰς πρώτας γενέσεις τῶν ζώων καὶ φυτῶν μηδαμῶς ὁλοκλήρους γενέσθαι, ἀσυμφυέσι δὲ τοῖς μορίοις διεζευγμένας· τὰς δὲ δευτέρας, συμφυομένων τῶν μερῶν εἰδωλοφανεῖς· τὰς δὲ τρίτας, τῶν ἀλληλοφυῶν, τὰς δὲ τετάρτας (pro τέτταρας), οὐκ ἔτι ἐξ ὁμοίων, οἷον ἐκ γῆς καὶ ὕδατος, ἀλλὰ δι' ἀλλήλων ἤδη, τοῖς μὲν πυκνωθείσης τῆς τροφῆς, τοῖς δὲ τῆς εὐμορφίας τῶν γυναικῶν, ἐπερεθισμὸν τοῦ σπερματικοῦ κινήματος ἐμποιησάσης." The noble philologist whom I ever cite when treating Empedoclean matter from an etymological point of view, because his activity on this (viz. classical) ground will hardly be accused of dilettantism, this worthy student has already himself interpreted this passage, in Latin, thus: "Empedocles legitur docuisse, animalia ab initio fuisse manca, necdum e membris conjunctis composita; deinde ista membra disjuncta casu coiisse; tum eas partes conjunctas fuisse, quæ ex se invicem nascerentur; vel potius, quæ inter se congruerent; tandem animalia non amplius orta esse ex particulis similibus, tanquam ex aqua et terra, sed per generationem." There remains, in short, to the classically educated modern geologist no doubt that the compiler of the well-known 'Placita Philosophorum' has digested the remnants of the same palæontological generalizations of our ancient naturalist which the latter proclaimed in his above-mentioned didactic poem; for we can assure ourselves that the whole genuine doctrine was deposited by Empedocles in his 'Περὶ Φύσιος,'—his other literary productions, the 'Καθαρμοί,' &c., never having possessed pretensions to contain philosophemes at all. Now, if we compare the announced four "γενέσεις" of this report with the yet traceable different stages of the palæontological development of organic life as latent in the ruins of the second book of the 'Περὶ φύσιος,' we gain the following results. The "γενέσεις μηδαμῶς ὁλόκληροι γενόμεναι, ἀσυμφυέσι δὲ τοῖς μορίοις διεζευγμέναι" stood, probably, on the same level with the "οὐλοφυεῖς τύποι" of the above poem; the "κόρσαι ἀναύχενες," the single heads, hands, and other members of the animal body "ἔμψυχα ὄντα" of which Johannes Philoponus makes mention bespeak another trait of this scale of development, though we cannot hesitate to assume that these living portions had to typify also, in such a phraseology, the very first phase of our philosopher's palæontological life. After this group came the "δεύτεραι, συμφυομένων τῶν μερῶν εἰδωλοφανεῖς," with which we could perhaps parallel the so-called "σύμμικτα ζῶα" of Empedocles as determined by the later commentators to comprise the "ἀμφιπρόσωπα," "ἀμφίστερνα," "βουγενῆ ἀνδρόπρωρα," and "ἀνδροφυῆ βούκρανα" as extant in the 'Περὶ φύσιος,' and the "εἰλίποδα κριόχηλα" ("κριτόχεια," Stein; "κριοειδέα," Reiske; "ἀκριτόχηλα," "ἀκριτόχειρα," Duebner) as handed down by Plutarchus. The third stage is described by the pseudo-Plutarchus thus, "αἱ δὲ τρίται, τῶν ἀλληλοφυῶν," which means animals (and plants?) composed of such members as to redintegrate one another in conformity with the laws still prevailing in the vital conditions of the organic world. With regard to their zoological (and botanical?) aspect, these pretended beings might have by no means differed from the fourth stage; or, because we can say unquestionably that our ancient naturalist considered the latter to be identical with the existing forms of the present configuration of things, they might have already possessed all the characteristic features of those animals (and plants?) which peopled, in the scheme of the Acragantinian, the surface of earth from the last catastrophe down to his own nativity. They are, notwithstanding, separated, as we have seen in the above pseudo-Plutarchian passage, from the fourth one. In regard to this group various MSS. have "τὰς δὲ τέτταρας, οὐκ ἔτι ἐκ τῶν ὁμοίων, οἷον ἐκ γῆς καὶ ὕδατος, ἀλλὰ δι' ἀλλήλων ἤδη," in which reading the philologists have substituted τέτταρας by τετάρτας, and I feel on my part very much inclined to substitute "ἐκ τῶν στοιχείων" pro "ἐκ τῶν ὁμοίων"; for otherwise the sentence would remain, in the ideas of a naturalist, quite unintelligible. These animals (and plants?) we find, then, separated from those of the third stage on the mere ground of their being no longer originated from the (inorganic) elements, *e.g.* from earth and water, but now from one another. Reducing this chronological secretion of the enumerated four "*γενέσεις*" to its original meaning, every one will concede that the separation of the third group from the fourth one has its foundation exclusively in the methodological aims of the author. The modern palæontologist will therefore recognize but three great phases into which Empedocles appears to have ranked the extinct types of animal (and vegetable?) creation, according to their palæontological development, without daring to assert seriously even the most ethereal affinity of such a tripartite division with the "Primary," "Secondary," and "Tertiary," or "Palæozoic," "Mesozoic," and "Cænozoic" epithets of our century. Here, then, of course, the question might arise, May all these neckless living heads, arms, and legs, all these double-faced, double-breasted creatures, bovine animals with human heads (fore parts), human animals with bovine skulls, and ovine beings hoofed so as to have a shuffling gait in a vaccine manner, or what these *εἰλίποδα* meant else, be conscientiously regarded as the fruit of geological observation on the part of our "*φυσικός*"? that is to say, Are they are no mere *à priori* guesses of a daring speculator fed on mythological crumbs and destitute of any inductive industry at all? The following words of Johannes Philoponus, commenting on the Aristotelian writing '*Περὶ ζώων γενέσεως*,' solve every difficulty. "*Ἐμπεδοκλῆς ἔλεγεν, ἐπὶ τῆς φιλότητος, τουτέστι, ἐπὶ τῇ ἥττῃ μὲν τῆς φιλότητος, ἐπικρατείᾳ δὲ τοῦ νείκους συναθροισθῆναι ἐν τῇ γῇ τὰς κεφαλὰς καὶ χεῖρας, καὶ τὰ ἄλλα πάντα μέρη ἔμψυχα ὄντα, καὶ αἴσθησιν ἔχοντα, εἶτα ἐκ τούτων ὥσπερ ἀπὸ ζώων πολλῶν γενέσθαι ἕκαστον τῶν ζώων.*" Johannes says here, expressly, that, according to the theory of Empedocles, there had been accumulated towards that epoch when the "*φιλότης*" commenced already to lose the government of the universe and the "*νεῖκος*" to gain the overcoming, viz. towards that time when the world commenced to extricate itself from a chaotic state and assume a physiognomy more or less similar to its present one, there were accumulated those heads, hands, and all other parts imbued with a vital principle (*ἔμψυχα ὄντα*) and (organic) sensitiveness "in the earth" ("*ἐν τῇ γῇ*"), and from these animal members afterwards originated the single types of the animal kingdom. Could we desire plainer, more striking language than the expression "*ἐν τῇ γῇ*"? Who would not suggest, at the very first sight, the idea that neither the Acragantinian nor the later commentator meant anything else than to refer to those hoary relics which, imbedded in the different strata of the rocky series of the tellurian crust, represent, here single mutilated portions of the bony skeleton of the vertebrata, there, again, the whole shell-armed bodies preserved of various Cephalopoda, &c.—to those hoary relics from which the genius of modern centuries has already succeeded in reconstructing the marvels of so many faunas and floras of creations entombed, which a noble-minded son of the North has styled the "medals of creations," and which we call in our daily tongue "fossils"? This "ἐν τῇ γῇ" affords, surely, the most ponderable evidence to convince posterity of the palæontological nature of all these wonderful monsters described in the 'Σωζομένοις' of our philosopher and all these "γενέσεις" mentioned by the pseudo-Plutarchus. The circumstance that Aristotle has not defined more particularly the conditions of the "βουγενῆ ἀνδρόπρωρα," that he has neither added the "to have accumulated in the earth," nor circumscribed their epoch in harmony with Empedoclean terms, will not annihilate the testimony given by his sober commentator; for the aversion of the Stagirite towards his renowned ancestors, his unconscientiousness or ignorance, which we have already had occasion to recognize when speaking of the "ὀρυκτοὶ ἰχθύες," his unconscientiousness or ignorance respecting the different achievements made by other Greek philosophers or gleaned by his compatriots from Nilotic lore, these drawbacks will probably balance the consequence attached as yet generally to his idolized authority; while, on the other hand, the accounts given, by almost all writers recording these abortive reconstructions, of these "βουγενῆ ἀνδρόπρωρα," "εἰλίποδα κριόχηλα," or of those living heads, hands, &c., never fail to connect the appearance of the same so-called monstra with the doctrine of the "φιλία" and "νεῖκος," with that of the Empedoclean great periods of cosmical disturbance and repose. Empedocles himself sang, in that part of his great work in which he dealt with this very cosmogonical development, thus:

> ......ἐπεὶ Νεῖκος μὲν ἐνέρτατον ἵκετο βένθος
> δίνης, ἐν δὲ μέσῃ Φιλότης στροφάλιγγι γένηται,
> ἐν τῇ δὴ τάδε πάντα συνέρχεται ἓν μόνον εἶναι,
> οὐκ ἄφαρ, ἀλλὰ θέλυμνα συνίσταται, ἄλλοθεν ἄλλο.
> τῶν δέ τε μισγομένων, χεῖτ' ἔθνεα μυρία θνητῶν.
> πολλὰ δ' ἄμικτ' ἕστηκε κερασσαμένοισιν ἐναλλὰξ,
> ὅσσ' ἔτι Νεῖκος ἔρυκε μετάρσιον· οὐ γὰρ ἀμεμφέως
> πω πᾶν' ἐπ' ἔσχατα ἐξέστηκεν τέρματα κύκλου,
> ἀλλὰ τὰ μέν τ' ἐνέμιμνε μερέων, τὰ δέ τ' ἐξεβεβήκει,
> ὅσσον δ' αἰὲν ὑπεκπροθέει, τόσον αἰὲν ἐπῄει
> ἠ 'πίφρων Φιλότης ἀμεμφέως ἀμβρότῳ ὁρμῇ.
> αἶψα δὲ θνῆτ' ἐφύοντο, τὰ πρὶν μάθον ἀθάνατ' εἶναι,
> ζῶά τε τὰ πρὶν ἄκρητα, διαλλάξαντα κελεύθους.
> τῶν δέ τε μισγομένων, χεῖτ' ἔθνεα μυρία θνητῶν,
> παντοίαις ἰδέῃσιν ἀρηρότα, θαῦμα ἰδέσθαι!"

We must, of necessity, confess that we disclaim the attempt to bring all the ideas expressed in these lines to a good issue in the interest of geological elucidation: thus *e.g.* we are unable to establish the part of the "*δίνη*" in these evolutions, nor can we entertain much hope of settling the question of the units of time intended by our philosopher for the production of the above monstra, that is to say, to fix the very epoch at which the "*πρῶται γενέσεις*" as described by the pseudo-Plutarchus had, subsequently to the "*συνέρχεσθαι πάντα ἓν μόνον εἶναι*" appeared on the surface of the earth, as well as the different intervals of time in the lapse of which one phase of palæontological development was followed by another. But we may still be sure that these animal forms were not meant by Empedocles to be mere abnormities of organic types as the Stagirite seems to have assumed. They were veritable reconstructions. Comparative anatomy alone enabled modern men of science to reproduce as by enchantment the huge forms of Ichthyosauri, Plesiosauri, Labyrinthodonts, of Sivatheria, Megatheria, and Mylodonts, or of the Dinornis and Ornithichnites. Nobody throughout the whole civilized world, laying claim to the title of educated, could now-a-days publicly avow his disbelief in the past existence of those gigantic beings which have left behind to our palæontologists no other vestige than some mutilated jaw, mere single teeth, or footsteps: so firm appears the causal connexion upon which this young doctrine, so peculiar to our century, notoriously depends. Yet, some twenty generations anterior to the epoch of our Christian reckoning, the philosophers who observed, and perhaps carefully investigated, the various fossil remains as extant in the tertiary, secondary, or primary groups of strata of their country, not only dispensed with the microscope, but also loathed any rigorous and instructive dissection of the Vertebrata, as a tender maiden loathes to touch a lizard, a serpent, or a batrachian. No wonder, then, if, in the mind of Empedocles, the huge skeletons of some Pachydermata, perhaps of those *Hippopotami Pentlandi* so abundantly spread over Sicilian caverns, excited the idea of his above-mentioned monstrous zoological phenomena, or if (what seems yet more credible) the mere mechanical connexion of the different portions of two or three entirely distinct species, genera, nay, even orders, effected eventually by recent agents, produced the same chimeras. Why not, if Scheuchzer was not doubted to have taken, about a century ago, Salamandrine remains for impious relics of antediluvian culprits—if the ploughmen in the vicinity of the Temenus Thyræ in Superior Lydia were eager to adduce the probably elephantine (Mammoth) tusks as bovine horns in proof of the legend according to which the almost certainly fossil bones denuded by a shower were the very remains of Geryones the son of Chrysaor and renowned as the proprietor of most superb cows? In short, the traits with which Empedocles will be found to be depicted in any relics of Greek and Roman literature—the phenomena of thermal water, the salses of Malacubi, and the active volcano of Mount Etna which he so passionately investigated, in his background,—his admirable early generalizations as to the existence of a fiery nucleus in the interior of the earth, and the volcanic upheaval of (crystalline) rocks by subterranean igneous forces,—his well-known speculations as to the physical formation of our planet, his apophthegms respecting the order in which the animal and vegetable types had made their appearance on the terraqueous surface,—all these traits, to which we may add the remarkable words in the fifth book, twenty-sixth chapter, of the pseudo-Plutarchian 'Ἀρέσκοντα,' and in the thirty-eighth chapter of the Galenian 'History of Philosophy,' viz., "he taught, first of the animals the trees grew out from the earth" ("πρῶτα τῶν ζώων τὰ δένδρα ἐκ γῆς ἀναδῦναί [Galen. ἀναφῦναί] φησι,")—or, more liberally, "he taught, the trees (plants) have anteriorly grown out from the earth, prior to the animals"—"before the sun had commenced to shed his rays upon the earth" ("πρὶν τὸν ἥλιον περιαπλωθῆναι") [Reiske corrected "περιαπλωθῆναι" by "περικυκληθῆναι aut περικυκλωθῆναι καὶ τὸν ἀέρα περιαπλωθῆναι," and Beck retained "περιαπλωθῆναι," and Sturtz translated this passage "antequam solis radii panderentur, antequam sol lucere primum inciperet"], "and before the day and night had been separated" ("καὶ πρὶν ἡμέραν καὶ νύκτα διακριθῆναι")—Tzetzes says with regard to the 'Works and Days' of Hesiodus simply "Ἐμπεδοκλῆς καὶ πρὸ τοῦ ἀπλωθῆναι τὸν ἥλιόν φησι φυτὰ γενέσθαι καὶ ζῶα," a peculiarity of theory also common to the Mosaic record, where plants appear sooner than the sun and moon,—all these traits, I say, as well as the characteristic aroma (permit me this expression!) spread over the whole of his thoughts yet preserved, excites in every geologically educated reader a certain sad, moanful sentiment:—why must remain altogether lost for us the sympathy of that exaltation with which he described the changes going on "in terræ voraginibus," "ἐν εὐστέρνοις χοάνοισι," and with which he seems to have compared his indefatigable activity to that of hounds?—

> "αἱ κύνες, . . .
> κέρματα (τέρματα Sturtz) θηρείων μελέων μυκτῆρσιν ἐρευνῶν!"

Nay, indeed, had the indifference of centuries and the imbecility of copying friars bereft us of the enjoyment of all these beautiful though obviously maimed ideas and at the same time indisputable merits, and transmitted only the report of Themistius, according to which, as we have already seen in the fourth chapter, "ὥστε Ἀναξαγόρᾳ μὲν ἡ κίνησις ἀρξάμενη, συνεχῶς *ἐστι, καθάπερ δὴ καὶ ὁ κόσμος· Ἐμπεδοκλεῖ δὲ ἐν μέρει, ποτὲ μὲν ἐστι, ποτὲ δὲ οὐκ ἔστι, ὥσπερ καὶ ὁ κόσμος,*" or any other tidings explained by later commentators respecting this doctrine of the periodical alternation of cosmical revival, struggle, and repose, together with those decisive words containing the "*ἐν τῇ γῇ*" of Johannes Philoponus above referred to, I should still feel no hesitation in taking for granted that the inclination of Empedocles to geology is decidedly more certain than that of any other ancient "*φυσιολόγος,*"—to hold it for at least as much to be relied upon by sound judgment as any other proposition relative to Hellenic matters in the history of philosophy.

So much for the Acragantinian. The preponderance of the Fatum in the Empedoclean circle of ideas gravitates also mightily towards such an assumption: "*ἀπὸ τυχῆς,*" in his view, happened the coalescence of animal organizations; and what could give birth to this conceit more rapidly than various fossil fragments in the strata, held by him to be tokens of repeatedly disintegrated attempts at creation? Censorinus says, in his 4th book 'De die natali,' that Parmenides adhered to the views of Empedocles as regards human origins at first through single members, "pauculis exceptis ab Empedocle dispensis." With him we must close the series of those naturalists who not beyond the periods I undertook to review might be proven to have been conversant with the great testimony of the crust of our planet. He was a Pythagorean, or, lest we should use incorrect epithets, he was initiated into the mysterious lore of this famous school. Many points of his scheme may have been derived from this source; nor was it ever my design to assert in every respect his originality. In physics he may have performed, really, the part of an "Eklektiker," as he is stated to have done this in the field of metaphysics; and in this case his palæontological theory, his four "*γενέσεις*" mentioned by the pseudo-Plutarchus, &c., might have possessed there the same prototypal analogies with those we have witnessed in our first chapter on behalf of a geological central fire. Perhaps the "*τετρακτύς,*" which, among its numerous holy meanings, signified a period of three or four days, supplied also a chronical frame for similar generalizations.

Beyond these it were difficult for the philologist to trace, in the literary remains, allusions to such fossils as would have given an object to Greek philosophers anteriorly to the Alexandrine era, unless we freely abandoned ourselves to such a lamentable discussion as, whether the proverbial old Latin "Omnis calx ex vivo," suggesting at first sight the strange idea that the microscopical nature of the chalk formation might perhaps have stood not totally alien to the happier of antiquity, be or be not referable to traditions coming to Latium from abroad.

One notable topic, however, cannot be passed over on this occasion. I allude to those pretended bones of fabulous giants "ἐν σοροῖς." The author of the pseudo-Aristotelian 'Θαυμάσια ἀκούσματα' belongs not to those who tell us of such marvels contained by mostly enormous metallic sarcophagi. He mentions, amongst other matter, fossils found in the Lydian pits (mines, μετάλλοις) near Pergamos, even human bones in a fossil state! Crœsus had already explored these mines; but afterwards, during a war, the workmen have taken refuge here. They have been smothered, the mouth being stopped. In later times their implements have been recognized to have undergone changes of this nature ("ἀπολελιθωμένα," "ἐλελίθωτο"). He also adds, "ταῦτα δὴ πεπληρωμένα οὗτινος ἔτυχον ὑγροῦ ἐλελίθωτο"; *i. e.* he attributes this fossilization to some fluid with which they became eventually filled up.

So the pseudo-Aristotle.

Of the other group, Herodotus is the oldest Greek writer, known to me, who speaks of such a coffin. In his first book, chapter the sixty-eighth, he describes those bones which the people declared to be the remains of Orestes: the coffin amounted to seven yards, the skeleton was by no means shorter. The smith of Tegea had dashed against it when digging a well. Similar traditions to this, relating to the discovery in Crete of the thirty-three-, or, as others say, forty-six-yards-long skeleton, attributed to Orion or Otos, to that, in the vicinity of Milet, of the ten-yards-long one attributed to Asterius son of Anax, to that of the eleven-yards-long one declared by the god in Claros to be the body of the Indian Orontes, to that in Dalmatia of those sixteen-yards-long ribs, and in Sicily, Pontus, of the tooth longer than a foot, to that in the isle of Eubœa of a hundred-yards-long skeleton inscribed Macroseiris and proclaimed to have lived five thousand years, to that in Carthage of a twenty-four- and a twenty-three-yards-long skeleton, or, at length, to the discovery in the Cimmerian Bosphorus of another twenty-four feet in length—similar traditions, I say, to the narrative of Herodotus relating to the discovery of such huge organic remains had, no doubt, already spread over Hellenic tribes within the periods I have undertaken to survey: the present state of classical literature furnishes us, nevertheless, with no further author, of the prime, who has recounted what we now learn from Plinius (vii. 16, 73, 74), Gellius (iii. 10, 11), Solinus (i. 90), Pausanias (i. 35. 5, 6; viii. 29. 3, 32. 4), Phlegon (Mir. 12, 14, 15, 16, 17, 18, 19). Prof. Lassaulx deemed himself fully justified in supposing that the misunderstood fossil relics of various enormous extinct species of former geological periods might have given birth to the Greek myth of earth-born giants: he takes for granted that there flourished in the dawn of history, anteriorly to any of the assumed stone, brazen, or iron periods, a certain widely extended worship, the followers of which had coffined these so-called bones of giants; indeed, the circumstance that almost all narrators add their having been dug out in such quadrilateral chests seems to confirm this dictum of the late Bavarian scholar. The historian of geology will undoubtedly penetrate deeper into the question of the authenticity of the fossil-worship, if the mysteries of Samothrace, the worship of the Cabiri, Dactyli Idæi, Telchines, Sinties, &c. be once revealed; for I am strongly convinced that there was an intimate connexion between them, and one could not dispel successfully the darkness or delusion which envelopes one link without deciphering the whole range of these allegorized and symbolized generalizations.

If we now risk a retrospective glance at the palæontological efforts of these periods, we cannot fail to draw some sharp lines of demarcation. No theory of this kind, save that of Empedocles, has reached us in a state even approximate to a cohesive logical arrangement of facts; yet we may confidently assert that the idea of progressive development pervaded, of almost all ancient thinkers, the inductive workmen of natural research as well as the deductive priests of their own idleness.

Diodorus Siculus distinguishes two groups of philosophers with regard to cosmogony. The one, he says, maintained the present physiognomy of things to be an immutable one from eternity; the other, headed, in the manner proposed, by Anaxagoras, whose disciple Euripides's lines we find there quoted, taught the gradual emergence of the world from a chaotic state. Hence the modern geologist would perhaps hastily infer that there came a school already in ancient days opposed to those proclaiming, in the history of life on the surface of our globe, a progressive development. But he would be wrong in doing so. We cannot name a single "φυσικὸς" from whose fragments or traditionary doctrine either of the following two propositions were altogether excluded, or, at least, inadmissible:—the evolution of our earth from an incomplete condition, and the later appearance of mankind on its surface than that of other organic beings. Anteriorly to Aristotle, Anaximander, Empedocles, Democritus, and Archelaus built up schemes whose peculiarities have not missed our ken. The two former read the autobiography of stratified rocks: in this case we may retrace their achievements. As to the two latter we cannot; we read, notwithstanding, of the intermediate stages through which our race, at least, had run, before attaining their present condition. The Abderitan described even what mankind learned from the different animal species in their rude infancy, what from the bees, what from the swans, &c.; the last of the Ionians mused on the aspect human affairs might have assumed before the foundation of towns. Aristotle confesses this gradual rise of cosmical life no less than Anaximenes, Heraclitus, Xenophanes, or Parmenides, Melissus, Zeno the Eleat, and Plato. Now, although we are unable to point out any geological merits of all these men, nay, even, can only be disgusted at their perverse disinclination to any such inquiry, we must concede that reflections upon mere moral phenomena could never have called into existence the doctrine of progressive development on such a comprehensive scale. The indications are on many occasions very minutely particular; sometimes we meet that solitary article of the probably lost scheme in harmony with which the appearance of plants had preceded that of animals in the beginning. I dare not mention here the possibility so to interpret the apophthegms of many philosophers as to understand the whole universality of males to have been produced in warmer, equatorial regions, the females in cold ones. But Anaximander and Empedocles might supply us with a ponderable example and encourage our steps towards more generous explanations. Let us for the moment restrict ourselves to a few final remarks.

We are verily entitled to speak of a progressive-development theory of the ancients; we ought, however, not to forget that the leading idea of their scheme falls noteworthily beyond any similitude with the scope of of ours. The succession of organic beings in cosmical time, as dreamt of by Greek philosophers, inwraps a progressive development not as effected by rising merely from simpler forms of life to the more complicated, but as realized by rising from forms often of stupendous complexity to forms ever more conformable to the well-known economy of nature. Hence we cannot be alarmed at meeting unexpectedly contradictory properties in the fabulous monstra which preceded, according to all such ancient theories, the present terraqueous fauna: it is on a theological principle that the ascending series here depends. The "βουγενῆ ἀνδρόπρωρα," for instance, appear surely as chimerical compositions, expressive of chimerical force, yet, when compared to the arising animal types, such as were also proclaimed by Empedocles to have followed the "σύμμικτα ζῶα," will, at first sight, bespeak their inferiority in the scale of biological contrivance.

The general prevalence of a doctrine of the degeneration of the human race might afford another obstacle to those who propose to determine the pivots of this progressive development. It is not only on the part of sacred poets that ejaculations have been uttered on account of such a supposed decay of human affairs and of mankind themselves, not only on the part of those "θεολόγοι" whom Aristotle himself distinguishes from the serious natural philosophers, but we find also in the Empedoclean and other Ionic, Eleatic, Pythagorean, &c. traditions the generations coeval with those thinkers styled mere "βρέφη" in comparison to that of their ancestors.

If, therefore, the groans about the golden, silver, and other metallic ages our race had undergone, obviously far from disparaging our above statement, seem yet incompatible with a theory of progressive development, we ought to enter more particularly into classical or, rather, philosophical inquiry, in order to decide how far the systematical aspect of the Greek geological periods may give some security. I shall accumulate in my larger work every detail in reference to the subject; previously I feel it right to add force to the fact to which I have already very often alluded, viz., our utter ignorance respecting the true succession of the several terrestrial inorganic and organic changes assigned to the various intervals of time measured by the same Greek palæontologists, and partly subordinated to each other, partly coordinated. As to Empedocles, it were not difficult to comprehend that, in conformity with the alternation of his "*φιλία*" and "*νεῖκος*," alternations which we find expressly termed gradual ones, the crown of his creation remained mankind after all, that is, amongst other matters, even in spite of their degeneration towards the approach of that very epoch at which the principle of "*φιλία*" was to commence to become exuberantly sensible, at which the whole order of things was nearer to a new chaotic complication than to its last evolution from a similar state of a catastrophical description. But we stand not at all in need of such exegetics.

Why may we not take it for granted that philosophers of clear judgment then also exclusively ascribed it to the mental faculties of man that his introduction was to be regarded as the completion of the ascending chain of organic beings produced by our earth within a whole mundane era? I cannot assume that the Acragantinian ever feigned more perfect those beings he eventually thought our very ancestors than his fellow-citizens, whom in his black sentimentalism he denounced as "*κοπρίων ἐκβλητότεροι.*" The progress of arts, knowledge, commerce, industry, &c. was recognized; and accurately those who at every step reproach human degeneration speak of the Dædalian Hercules in the vicinity of the Corinthian Minerva Chalinitis as of a work which bears yet the traits of imperfect attempts Empedocles may have exclaimed that he is an exiled god condemned to wear a human body; he may have exclaimed that this world is an "*ἄντρον*" something like a valley of pains: even then, if he had reconstructed, from the fossil skeletons of tertiary Pachydermata, for himself giants, titans, &c., the point of view above referred to, viz. that regarding the zoological features of the successive "*γενέσεις*," that point of view, I say, will save the modern geologist from the danger of contradictions.

Quite different may have been the views entertained by Greek sacred men of science. I submit that their predilection to muse on the primeval happiness of the paradise lost must have, in this respect, rendered sound judgment altogether impossible. Whence this dogma originally came, we have no space at present to discuss. Thus much holds true, that we meet it everywhere among those who ever cared more about social affairs than cosmical intuition.

The last two great celebrities of the periods I have undertaken to sketch, Plato and Aristotle, had little share in the investigation of these topics. The former suggests a strange tale to the comedian Aristophanes, in his 'Συμπόσιον,' in order to take vengeance for his cherished master; the latter boasted of having conceived that the universe has nothing in common with a bad tragedy, and was not aware that his indifferentism with regard to the changes of, as he called it, sublunar nature, bereft him of so many sentiments on a far greater, nay the greatest scale of the tragical!

CHAPTER VI.

Such are the results I have obtained by many years' incessant labour. It will at least appear from them, that when the better race of Greek philosophers speak of an infinite number of worlds, they generally refer to time and not to space,—that whenever they celebrate by their song the vicissitudes of inorganic as well as organic life, destroyed from time to time by the assumed κατακλυσμοὶ and ἐκπυρώσεις, and revived again by other ἀποκαταστάσεις, they ought to be regarded as precursors of our geologists.

Now, it would be foolish to compare these attainments with those of modern naturalists. Nor can we with certainty say anything about the great extinct civilizations of the Egyptian, the Babylonian, the Zend, the Sanskrit, or the Chinese; for our information on that topic has, till lately, been very deficient. Mexican civilization falls beyond the sphere of normal analogies; and the Etruscan, as far as we can judge, sheds no favourable light upon the merits of Grecian antiquity; nay, even the Roman seems to have manifested a better inclination. It was a great indiscretion on the part of some modern scholars to term such an inductive people barbarians. We should equally consider it affectation if we were to point out how many lines Horatius copied from Alcæus, Alcman, Myro, or Sappho, but not when we recall to memory the palæontological collection of Augustus at the Isle of Capri, or when we read the literary remains of a Marcus Terentius Varro, a Columella, or a Palladius, and meet with "consualia," "volcanalia," and "opeconsiva."

Out of the number of the observations, investigations, discoveries, and generalizations above enumerated, there are certainly many which draw their origin from sources exterior to pure Greek industry. The palæontological theory of Anaximander will perhaps ere long be demonstrated to have a traceable descent from those early Nilotic speculations from which, according to some writers, the writer of the Pentateuch borrowed his geological tableaux of the "six days." This applies, however, better to astronomical notions than to the geological initia extant from these periods.

As to the whole question, I repeat earnestly what I said in my first chapter, when dealing with the question as to who was the author of the heliocentric system as propounded by the 'Laws' of Plato,—viz. that I would wish, whenever gorgeous scientific victories are made to depend upon mere compliments paid by the profane multitude of prepossessed writers to the genius of one individual, to substitute in the history of science, for vehement catastrophical factors, agents operating slowly in proportion to human life—fatally, nevertheless, in the lapse of enormous intervals of time—in like manner as Sir Charles Lyell has done in strict geological philosophy. Therefore I felt inclined to connect the origin of the heliocentric system with the greatness of the "Su-ten-het-si-Ra"s; and therefore I did not wish to end with the name of Pythagoras. The philologists were for a long time misled by the school of Meiners, who maintained the existence in Greece of something which he called "autochthonous civilization." We have certainly more encouragement to regard the different races of man, &c. as constituents of independent "Faunas," into which the surface of our globe is naturally divided, than a generation had which could not rise to the appreciation of the works of George Samuel Morton or Agassiz; we have, however, on the other hand, others to guarantee us the antiquity of man than those whose Egyptologies were confined to the toyings of a Father Kircher, as well as others to admire the busy sedulity of so many chiliads than those who affected to prove every thing and every discovery to be an unphilosophical fancy, if it was not in conformity with Bentleyan criticism. In short, there have always existed philosophers anxious for the honour of the Caucasian race, and who, remembering the proud assertion of Flavius Josephus, that all nations renowned for their scientific attainments (the Egyptians, the Babylonians, the Magi, and the Hindoos) borrowed their wisdom from the Jews, hesitated to own the importance of the Greeks, affirmed by history to have been conversant with those "barbarians." Now-a-days we have sufficient security against possible perplexities of this kind.

It is highly probable that there are still hidden under the vaults of some oriental cloister, now resounding with the liturgy of whining friars, manuscripts the possession of which would supply us with further data for the enlargement of our second, fourth, and fifth chapters. Moreover these data might be of themselves important, though probably they would not interfere with a verdict given by the historian upon those already alluded to. For, if it be conceded that we know, besides the Achelous and the Nile, the Pyramus and the Salmydessus, twenty or thirty other rivers whose alluviatile operations have been registered in the annals of the Greeks, and that circumstantially we are acquainted with the theories of forty or fifty *φυσικοί*, proposed by the latter in attempting to decipher the past of the universe from the present configuration of things, and not only that of Empedocles, the considerations would be, even in that case, by no means invalidated, by which we are driven to the belief that the Greeks have neither appreciated the just meaning of the fossiliferous strata, nor fixed that of animal and vegetable types, and especially not that of species. If we are unable, from their slight literary remains, to define what those generations, in their prime, in fact performed, we may at least circumscribe what they did not, and satisfy our conscience.

Such is the sentence we pass upon Hellas :—

We see cosmical investigation checked in that classic peninsula, and particularly in Athens, in those "green valleys in which the clear-voiced nightingale poured forth her sweet lament, under the shade of the dark ivy, and the sacred foliage of Bacchus, covering abundant fruit, impenetrable to the sun, and unshaken by the blasts of all storms;" in these valleys we see cosmical investigation checked by the same obstacles which are now retarding the progress of science. Naturalists absorbed in thought were even at that time a laughingstock; the "flea's-leap-studying pedant" of the modern romancist is far from being a new figure. Aristophanes brought him long ago upon the stage, in his Chærepho. The population of the Attic metropolis hated, indeed persecuted natural philosophers, the so-called *μεταρσιολέσχας*, as appears from the Plutarchian biography of Nicias and Pericles; for public attention in that city soon became exhausted by the affairs of state, and even shoemakers were disturbed in their dreams by the idea of an "*ἁπλῶς ἀρίστη πολιτεία*," the perpetual nightmare of Plato and of many other ensnared geniuses as early as the age of Themistocles.

It is no wonder that, enjoying democratical institutions and under restrictions with regard to numerical force, "these descendants of Erechtheus, happy from ancient times, favourite children of the blessed gods, plucking from their sacred unconquered country renowned wisdom as a fruit of the soil, and constantly walking, with graceful steps, through the glittering air of their heaven, where the nine sacred Muses of Pieria are said to have once brought up the fair-haired Harmony as their common child," should have shown rather an aversion to the contemplation of the universe. But are we therefore to conclude that in that form of government, so worthy of human dignity, the germ of this neglect of cosmical education is inherent?

I apprehend that those who allege for this purpose the ancient Greek colonies of Italy will never be able to verify their speculations, because the history of civilization can refer to an example far more decisive and far more instructive, to Albion. The vicissitudes of Syracuse and Metapontum, of Sybaris and Croton, belong, in this respect, to the same ætiology as those of Athens; the only difference was effected by the caprice of yawning tyrants. Where is there to be found a constitution fruitful of more political freedom than in England? Yet where has more been done in the service of the great work of the study of Creation than in that envied land? The government of Russia devotes annually several millions for observatories, while that of the States of North America contributes a sum for the same purpose which sinks into insignificance when compared with Muscovite liberality; yet will the annals of the intellectual history of mankind therefore reprobate Transatlantic republics, and excuse Russian despotism, when recording the actual achievements of the two nations? But such an argument only partially excuses the indifferentism of the Athenians.

Another obstacle to scientific progress took its root in the religious thraldom which stunted their civil condition. The Greek priesthood was more ignorant and more petulant than any priesthood ever was, not to be paralleled with the Egyptian, Babylonian, or Hindoo—noble castes, the exclusive bearers of national improvement: they stood surpassed in scientific qualifications, as is obvious from the affair of Cleanthes, even by the ladies of Piræus. We ought not, therefore, to be at all astonished that the Pythia declared Socrates the wisest of all mortals—him who, we must say, in spite of his exalted martyrdom, poisoned every desire of a higher knowledge, and, in this sense, really corrupted the youth of Greece. A modern historian of repute has styled the elder Cato a Don Quijote, probably because it pleased him with such a paradoxology to titillate a public of philological dilettanti. I must always be opposed to Forchhammer's saying, that the Athenians were right in condemning Socrates to death, because his tenets tended to overthrow their democratical institutions; but when viewing the subject in its relation to science, I shall never confound the motive of comfort with that of thirst for knowledge.

Men are to be met with in our own days whose mental structure exclusively fits them to observe from moral points of view—men who are unable to rejoice at cosmical or metaphysical acquirements—who ask, pace for pace in their learned deliberation, for an application to practical advantage. To speak with men of this description upon scientific matters would prove to no purpose; for such people are born so that they do not feel the need of science. They will never be convinced that the aim of the latter, when it seeks to ascertain the distances of planets, is nothing else than to bring us to comprehend both our position and lot in space; they will never be convinced that a veritable scholar may study such things merely because he desires to know them; on the contrary, their belief was, is, and will remain for ever, that the student who proceeds this way must either pant for some personal renown, or must be a madman, who will, perhaps, end by putting his brains upon the rack to invent a method of connecting the celestial bodies with the earth by a telegraph; in short, their belief will always be that the student who deals with these subjects, if not ambitious and not crazed, must have a mind to make merchandize of them, and so to treat them that they may yield to him a profit. They will naturally give a partial and defective definition of the "profit" every earnest student of science is working to obtain, a profit which differs essentially from the one which is to their minds the only road to human greatness.

Nor can they think otherwise. For although a pursuance of their principles may lead to a high national position, nay, may even exercise a beneficial influence on our social existence, yet we must maintain that they fill up an inferior position when compared with the inspired workmen of science, and stand, in the scale of intellectual organization, less remote from the brute creation. To this class belonged Socrates, and he from whom we learn his history better than from Plato, Xenophon himself.

The ancient Greek natural philosophers were reproached by Socrates with being unable to produce, if occasionally required, wind or rain, &c., however might they strain their wit in refinements about the origin of all these phenomena. According to the judgment of this "wisest of all mortals," it would be sufficient to cultivate astronomy only as far as it may serve to the recognition of the parts of a year, month, or day; and this knowledge might be obtained through a conversation with town-criers and steersmen. To go further than this, to extend the ken of our intellectual powers to the planetary and cometary orbits, he deemed not only superfluous, but even dangerous. Of geometry, likewise, he permitted only so much to be acquired as might be necessary for the affairs of purchase, bargain and sale, and for the surveying of fields. To stray into problems of a more complicated nature would consume human life in vain.

Such were the reproaches addressed to the "φυσικοί."

Now, a man who would have the youth learn the marvels of the starry heavens from town-criers and steersmen seems at the first glance, in the eyes of our age, to have already branded himself, and to have caused no serious trouble to the march of science at all. Yet the delay to which cosmical observation became subject in the period subsequent to those I deal with, and most sensibly in the centuries antecedent to the second renaissance of western culture, undeniably drew its origin from the charm this "torpedo" (as he was surnamed by that people of gapers, who were not wise enough to elevate themselves above his contradictions) exercised on a considerable number of cowardly generations. They had not moral courage enough, in fact, to convince him of the charlatanry he committed when attempting to refute the Clazomenean philosopher by means of such arguments as these:—"The sun cannot be a *μύδρος διάπυρος*" (a fiery stone); "for the fire destroys vegetable life, whereas the sun enlivens it; the sun blackens bodies, the fire not; the stone cannot endure in fire, the sun has illumined the world since an eternity," &c.; nor to arraign his stupidity when he objected to natural philosophy, that each "*φυσικὸς*" tries to explain the phenomena in a way altogether diverging from that followed by another, nay, even in a way altogether opposed to it—evidences with which he attempted to embellish his youthful apostasy from the study of the "generatio æquivoca," forgetting that this divergence of hypothetical pursuits was far more strikingly to be illustrated by the party fury of the moral philosophers of Greece indulging in the problem of the "summum bonum." It was chiefly in consequence of this reputation of Socrates that the ancient Greek natural philosophers have become the objects of such lamentable treachery. The historians of philosophy embroiled the facts and excited dissension: the noble and ingenious efforts of naturalists, as regards their intentions, though unfortunate with regard to what they achieved, have been slanderously classed with the impertinent aims and follies of a Schelling, that wanton disturber of the modern peace of the Indo-German intellect.

We may thus regard him as a mere advocate of practical life, who spent his own in analysing the errors of almost all classes of human society, and incessantly pursuing the phantom which he thought might be termed "virtue," without ever being able to feel, in spite of his "spiritual midwifery," any nearer approach to the perception of wherein, after all, this "virtue" consists.

We may regard him as a mere political agitator, who never attained to the dignity of a true moral philosopher; for the latter will, while continuing the direction pointed out by his own frame of mind, never assail those who cultivate the other great branches of intellectual life, the metaphysical or physical; on the contrary, he will esteem such a distribution of force necessary. His dull objections against cosmical philosophy uttered in the shops of carpenters, shoemakers, saddlers, and helmetmakers, added the stamp of quackery to his unquestionable rudeness; his economical receipts, as in the case of Ceribus or of the steward, added to his repute nothing common to that of men like Anaxagoras.

Honest enthusiast, in other respects, as he was, he would have expressed the memory of the most distinguished adversary of Greek cosmosophy without cankering the coming civilization of whole nations, had not his scholars Plato and Xenophon (the former being incomparably greater than his master) stirred up his manes and rendered him hateful and despicable to the noblest class of men, to natural philosophers. Then came Christianity, albeit the days of

Newton came not yet nigh, when the admiration of the magnificence of Nature is no longer identified with atheism. A so-called "philosophy," which excited uproar against cosmical speculations with the watchword "Know thyself," a watchword extremely ambiguous, extremely equivocal, extremely misinterpreted, and conceived with extreme partiality, was taken up by the bigoted churchmen of the first centuries as devoutly as it was taken up at one time by the Pythia. The Bishop of Cæsarea and others had exhibited heartfelt resignation; nay, they were ready to create him, simultaneously with Plato, from whom they heard of all these things, a Father of the Church, or at least a kind of seer who had had a mission from Providence, though he had only been allowed to see it darkly.

So the selfish progeny who overlooked what might have proved, as explained by Lord Bacon, salutary in the inductive method followed by Socrates gave the lie to history for the sake of what was only pestiferous.

However it be, he became a martyr of political freedom, a martyr whose pains from the poisoned draught in that cold, wet dungeon, whose soul-breathing eyes, growing dim from spasmodical convulsions, remain to the millions who vegetate in social existence a motive of uneasiness for ever. But respecting his blind antagonism to science, it were by no means difficult for the student of our age to quiet, in spite of his peculiar mental traits, his assailants; for I am strongly convinced that, if he had had the opportunity of looking through the microscope of Prof. Ehrenberg, and distinguishing in a cubic inch of the Bielin Polierschiefer forty-one billions of *Gaillonella ferruginea*, he would surely not have desired to die merely that he might examine the notions of Minos and Rhadamanthys, of Agamemnon and Achilleus, about that vexed "virtue," even in the gloom of Hades; I am strongly convinced that, if he had been permitted to look into the magnificent refractor of Lord Rosse, and determine nebulæ of the sixth rank into myriads of mighty suns, he would have hardly said that he who knows nothing is "wiser than other human beings, because as the latter, believing that they know anything, know, in fact, nothing, so he, knowing nothing, never believes that he knows anything."

With these antiquated advocates of "practical advantage," we ought not to confound the so-called Sophists, another ponderous impediment to the progress of Greek science. "At once eminent and personally unpopular" (in the phrase of Grote), they are now but seldom to be easily distinguished from the class of the *μεταρσιολέσχαι*. Several of them thus stigmatized at Athens seem to have rather deserved the very name of *φυσιολόγοι*. Hippias of Elis deserves, at least, a better place in the rank of the natural philosophers than thinkers like the Samian Melissus. I allude here, however, to those who, being disappointed metaphysicians, though, in other points, men of good conscience, endeavoured themselves to discourage their pupils and divert them from metaphysical pursuits, and, again, to another group, corrupted in the boldest meaning of the word, who were governed in their sayings and doings by mere ticklings of the locutive faculty, or by a mere instinct of imposture. As to the former, I make use of the words of that illustrious historian above referred to. "The negative side of Grecian speculation," he says, "stands quite as prominently marked, and occupies as large a measure of the intellectual force of their philosophers as the positive side. It is, more simply, to arrive at a conclusion sustained by a certain measure of plausible premise, and then to proclaim it as an authoritative dogma, silencing or disparaging all objectors, that Grecian speculation aspires. To unmask not only positive falsehood, but even affirmation without evidence, exaggerated confidence in what was only doubtful, and show of knowledge without reality—to look at a problem on all sides, and set forth all the difficulties attending its solution, to take account of the deductions from the affirmative evidence, even in the case of conclusions accepted as true upon the balance,—all this will be found pervading the march of their greatest thinkers." These philosophers would scarcely have been able to appreciate the good fortune of occasionally finding fossil bones of the *Mesopithecus Pentelicus* in the rocks of Pikermi; nor could they have promoted the first crude geological attempts, within their social reach, ventured by Archelaus and others.

As to the second constellation of Sophists, viz. those who were slaves to loquacity, I can only say that men of superior accomplishments who are puerile enough to abuse the weakness of the language of their nursery, and to puzzle a public of profane theatrical taste with riddles like that of "τὸν λέγοντα σιωπᾶν," would have hardly done service in any age and in any country to the aims of science; but in Athens, amidst the demagogical alarm, they grew and became the greatest obstacles to the comprehension of the work of creation. For the naturalist was obliged, if intending to attract a literary circle, never to relax his scruples, since he could never be immediately aware what troublesome misinterpretation his or his adversary's "infinitivus" bound up with an "accusativus" might encounter.

More corrupt than these were a third set of the Sophists, creatures deserving this surname in its least-flattering application; for they pursued a most infamous intellectual prostitution. When raging, "τὸν ἥττω λόγον κρείττω καὶ τὸν κρείττω ἥττω ποιεῖν," they not only injured their fellow citizens, but they troubled also the crystallization, so to say, of scientific induction, as based upon ethnological, zoological, botanical, mineralogical, geographical, geólogical, and palæontological observation. The Greeks were, besides, possessed of an almost marvellous predilection in favour of the grossest lies. Travellers returning home from remote regions may only have abused the mirth of serious thinkers, or perverted the notions of those to whom scientific "*διαδοχὴ*" was exclusively and hopefully looking, thinking they would preserve more securely their name for the approbation of posterity, or at least of their age, if they forged them some "*θαυμάσια ἀκούσματα*" as to nations destitute of mouths, of tribes having twenty fingers, or of rivers soaring upwards into the atmosphere, than if they had described modestly and honestly what they witnessed.

Finally, I may allege the Homeric Poems as a notorious impediment to Greek scientific progress. We may see from the 'Dialogues' of Plato and from the dramatic remains of the pre-Alexandrine period, how piously ancient poets in general were insisted upon by the inhabitants of that peninsula; and we see also for what an essential part of education their dithyrambs, scholions and hymns, dull as they sounded, were taken by their most renowned legislators. Instead of making use of them for the moral government of mankind, they have been relied upon, in most cases, as the very receptacles of all the wisdom which during his whole life a mortal might entertain, cosmical matters not excluded. But it was the pressure exercised by the hexameters of the 'Iliad' and 'Odyssey,' of the 'Homeric Hymns' and 'Epigrams,' on the Greek, which chiefly retarded the progress of cosmical investigation. As the English their Bible, so venerated they the Homeric Poems: it was more than a mere fashion to quote lines from them; and whenever the questions of the day excited alarm, the lettered of Megalopolis and Corinth, of Argos and Milet, took refuge in their authority, not less eagerly than some grave farmers of Norfolk or of Aberdeenshire in theirs for the sake of being quickly set at rest about the *Gorilla Gina* and the *Ægilops ovata*, the *Niam-Niam* and the "flint implements in the drift." To the same category belonged the didactics of Hesiodus. Their perusal proved still more dangerous for youth, in consequence of their being intended as a substitute for the cosmogonies of observing natural philosophers. Hence it becomes clear why Xenophanes of Colophon was so angry with these extolled versifiers.

Now, amidst these groups of petty misgoverned republics, amidst their butcherly epopts, hierophants, their exalted warriors, unconscionable poets epic, lyric, dramatic, didactic, their impertinent orators, their incomprehensible agitators, their impudent sophists,—amidst their opulent vagabonds, fuddled, splitting their sides with laughing, their waggish, pert youngsters, ignorant and vain, always in expectation of being elected admirals of the fleet or at least generals of cavalry,—amidst their merchants, monopolizers of voyage and travel, their ladies of pleasure monopolizing female civilization, their wreathed pæderasts, their garlanded dancers,—amidst their soothsayers, sibyls, flute-players, citharists, barbitonists and traders in ointments, it is chiefly their natural philosophers, their *φυσικοί*, who merit our sympathy. Although sometimes uttering apophthegms we could now gather from the most common idlers in our streets, they appear grand in their philosophy, and grand in the antagonism of their misery. Several of them, Thales, Anaximander, Anaximenes, Pherecydes, Pythagoras, Xenophanes, perhaps Heraclitus, Anaxagoras, Empedocles, Archelaus, Aristotle, Democritus, antedated the intentions of modern geologists, being themselves, for the most part, nothing else but geologists of abortive design. In the course of a long life of indefatigable investigation and induction, they embraced a diversity of phenomena which strike modern naturalists with surprise. They reflected on the Milky Way as well as on the bitterness of sea-water, on the process of respiration not less than on the origin of colours, on the property of blue or black eyes not more than on the sanative power of the plants: nay, even, they went further; they sought after the principles which might advance the happiness of mankind in their social and political life, they dealt with the idea of the beautiful, and, having wrought through all these studies, they cultivated the flute and the lyre, asking, in the mean time, whether all these things have a real existence, whether all make up but One, whether they originate and cease absolutely to exist. Now, to become a metaphysician or a natural philosopher depends chiefly upon one's intellectual organization; yet the Greek thinkers were also seriously influenced by the unworthy dimensions of their own cosmical information. They became forced into metaphysical studies because they too rapidly reached the assigned boundaries of the material world; and the "*κενὸν*" which many of them placed beyond the starry sphere led them inevitably to the questions of transcendental philosophy. Plato affords us, in this respect, the best illustration—he who could not resist his unhappy dualism, but filled up the void exterior to his material *κόσμος* with the conic sections, so to say, of his celebrated "ideas."

The *φυσικοὶ*, however, in spite of all their impotence, aided by no optical, by no chemical instruments, arrived at a grandeur of conception overwhelming to mortal imagination. Their material universe was so diminutive that it now appears worthy of contempt. According to the most accomplished of their philosophers, the cosmical radius, *i. e.* the distance of the starry sphere, supposed to be the boundary of the material world, from the earth as collocated in the centre of the universe, did not exceed 16,000 miles in conformity with our reckoning. A cosmical diameter, then, of 32,000 miles, not two-thirds of the distance modern astronomers assign to our satellite! Yet this petty universe, as forged by their defective ἐπαγωγή, did not prevent their subjective magnificence. The melancholy fate to which for the most part they fell victims, in consequence of their efforts to decipher the history of the universe, will for ever supply the highest tragedy of man. For what are all the Œdipus and all the Hamlets of the moralist or psychologist, when compared with a Pythagoras, who so readily submitted himself to every abstinence and every pain, even to castration, in order, from Nilotic lore, to enlarge his views concerning the frame-work of Creation?

But the impulse which gave birth to this nobler class of φυσικοὶ never came from Greece; it came always from abroad. A very humiliating truth, which Plato could not help confessing—Plato, so true an embodiment of Greek character—is contained in the words which, in his 'Τίμαιος,' he puts into the mouth of an Egyptian priest: "Oh! ye Greeks remain always children; an old Greek does not exist at all. Ye are young in your minds; for ye have not inherited the tradition of an antiquated glory, nor of science grown old by the lapse of ages!"

I repeat that, on the whole, the Greeks exhibited rather an aversion to cosmical investigation. They witnessed, probably, the dances, introduced also in Athens, to celebrate the doctrine of the world's periodical destruction, with some interest; but to examine the section of the several fossiliferous strata as exposed to daily view in their country, to collect fossils from those beds, or to conduct excavations, they felt no allurement. On the contrary, they seem to have taken hold of the advice of their Praxilla, and dared not to touch the stones of the field, fearing they might hit against a scorpion. Hence they were not at liberty to decipher, from the stratified cemetery of the tellurian crust, the infinite wisdom imprinted by Creative Power on faunas and floras now millions of years departed: hence, reconstructing only stupendous centaur-like monsters from fossil remains superficially glanced at, they were disgusted by the remembrance of this very earth, or put in fright by its buried treasures; hence the Hecabe of Euripides well invokes her, before burying herself in the abysses of the sea, as the "mother of black-winged dreams."

Schleiermacher surely disgraced himself when, instead of excusing the divergence of the mental organization of the Greeks, he attacked outrage in favour of their pretended classical worth in natural philosophy. I think otherwise. I am convinced, and every sober scholar will be so, that yon Philoxenus, engaged in a pit where he could probably meet with fossil relics, incrustations or impressions, meditated immediately upon some gorgeous tale (if these relics really drew his attention away from the sorrowful event of his imprisonment), for the purpose of connecting the origin of these terrestrial phenomena with the adventures, for instance, of the shield of Hercules, instead of connecting them with the analogy of similar species alive on the surface of our globe and inferring the changes which geological catastrophes might have produced. I am convinced that this people, who admitted into their literature no love song, and who went with lips as mute and rigid as the gods Olympic, sculptured by their masterly style, themselves, were predisposed to contract a cold melancholy from the insupportable aspect of human affairs, and unlikely to lay aside a sentimentalism apparently so congruent with their ἑλληνίζειν, in order to play the devout in cosmical discoveries.

All the five senses appear in them highly developed. Perhaps this exalted them in a manner so unfavourable to the modern direction of science —that they were conducted as positively by their auditory organ in their philosophy as by their extremely fine nose or their fondled gustative nerve; perhaps this caused, as to the actual configuration of things on the surface of our planet, their utter indifferentism—that their imagination, frantic as it was, rendered their most cursory conceits, their most volatile lies, a benumbed group of statues, a lifelong object of their adoration.

Preferably sculptors, painters, musicians apt to perform at religious gazing as on a seven-chorded lyre—lawyers, physicians, foot-soldiers, seamen—cooks, jesters, gymnasts, coachmen on trijugal, quadrijugal cars,—subtle, ambitious, perfidious, quarrelsome—never so prone to curiosity as to pertness in their conclusions—always more acute than profound,—thus fulfilled the Greeks their historical duty, and such is their fame, transmitted to posterity on every stone they cut, and on every tablet they inscribed.